MAR 16 1960

ENGINEERING • CONSTRUCTION • OPERATIONS

PIPE LINE INDUSTRY

MARCH
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Corrosion: Special Report

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HIDDEN HAZARD
Old Abandoned Pipe May Cause Trouble 45

Plus . . .

FAST PAYOUT
Batching Two-Phase Flow with Spheroids 47

For a "Quick Look" at this issue, turn the page . . .

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MAR 16 1960

PIPE LINE INDUSTRY

A GULF PUBLISHING COMPANY PUBLICATION

March 1960 | Vol. 12, No. 3

CONTENTS and Quick Look

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

CORROSION/SPECIAL REPORT

Planning the Corrosion Control Program

☐ Here's the way Texas Eastern carries out a highly efficient corrosion control program which is an integrated part of a general instrumentation department. After all, why not combine corrosion control with other instrumentation functions such as measurement? This can reduce travel—which takes most of the time of many corrosion engineers in the field. Instrumentation is instrumentation, and a trained man who can handle corrosion tests etc., can also take care of meter and instrument problems.
By Pat H. Miller.....Page 24

How Weather Affects Cathodic Protection

☐ Whether it is cold or hot makes little difference in current required to protect a pipe line. However, rainfall and to a degree, snow, do affect the requirements. In a test conducted in Pennsylvania, where a bare line was under 30 inches of cover, it took a 0.5-inch rain to affect the requirements. The maximum effect came from a 1½-inch rain. Additional rain had little added effect. Weather-bacterial effects were also studied.
By F. E. Costanzo.....Page 32

New Design Featured in Concrete Coating Plant

☐ Overcoming problems of contamination from air moisture with dry cement in its unloading and storage system, Pipe Line Service Corporation has improved efficiency of Harvey, La., coating yard. Using underground storage and dehumidified air pressure system, moisture contamination is eliminated. System has separate applicators for small or larger diameter pipe.
By Donald G. De Pugh.....Page 38

Keep the Over-All Corrosion Picture in Mind

☐ Especially when dealing with impressed current installations. Big money is riding on many seemingly simple decisions. The choice of a ground bed, for instance, can mean higher or lower current requirements for years and years. Spacing of the units is equally important. In other words, like good athletes, corrosion engineers must always keep the fundamentals in mind.
By Wm. A. Hutchison.....Page 40

Cold Mastic Applied to a Products Line in Service

☐ When the line had to be relocated to make way for a lake, Marathon decided to take the opportunity to recondition a 6-mile section while it continued to operate. Three men applied the mastic at the rate of 1,500 feet per hour.....Page 44

Old Abandoned Pipe Line May Be Source of Trouble

☐ Don't fail to check out this possibility when a particular area requires excessive current for no obvious reason. Sometimes the problem may stem from an old line laid in the same ditch; other times it will come from abandoned water and oil lines.
By John Emery.....Page 45

Batching Two-Phase Flow with Spheroids

☐ This is the best answer so far to a vexing problem. Colorado Interstate devised an automatic spheroid launching system which pigs its 16, 18, 20 and 24-inch gas gathering system in Oklahoma where gasoline collecting in sags was playing havoc with flow efficiencies. The automatic pigging system recovered one million gallons of gasoline in just two months—December and January. In addition, it greatly enhanced the flow efficiencies of the lines.
By David W. Bean and H. Norman Eagleton..Page 47

PIPE LINE INDUSTRY published every month. Entered as second class mail matter July 9, 1954, at the post office at Houston, Texas.
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Coal's Charges Need to Be Answered

". . . On the basis of current known findings, discounting future discoveries, authorities estimate U.S. oil reserves at 12.7 years. The comparable figure for gas is 22.9 years."

". . . From the attitude of the oil and gas industries, the uninformed might conclude that the energy industries are completely free of Federal or state regulation, and that the coal industry seeks to bring government, for the first time, into this field (established a national fuels policy).

". . . Because of the time needed to explore, an estimated three to five years is needed to bring in one producing well. And the time needed for pipe line construction, plus production delays, would hamper the gas industry's quick conversion to emergency status."

THESE THREE STATEMENTS are direct quotes from a 19-page attractively bound propaganda booklet given wide distribution by the National Coal Policy Conference in support of a national fuels policy study. The statements not only are misleading, they are incorrect.

The first statement was presented without mention of the fact that the liquid hydrocarbon reserves ratio has fluctuated between 12 and 13½ years for several decades, and that such ratios will continue.

The second statement has no basis in fact. The oil and gas industry simply wants to keep federal controls at a minimum, not increase them. After all, this country has thrived on free competition, not on government domination.

The third statement is equally incorrect. It was made as an argument to support coal's contention that a national fuel's policy study is needed for national security. Did oil and gas fail the United States in World War II . . . when no comprehensive fuels policy existed?

Such misstatements put further emphasis on the urgent need for the oil and gas industry to organize its forces so that the government and the public can have the true facts about the industry. The American Petroleum Institute's recent information kit answering coal's charges in the national fuels policy debate was an excellent effort toward this end. But much more needs to be done.

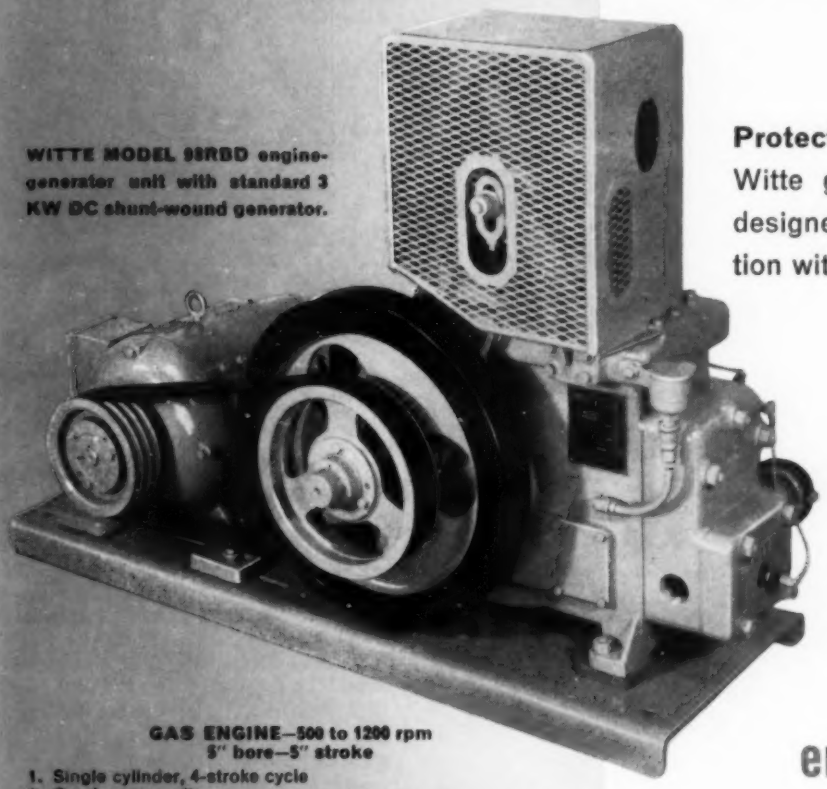
A similar information program should be conducted to undo some of the damage caused by recent antitrust trials against the oil industry. The general public should be informed that the Justice Department's recent failure to convict 29 oil companies of price-fixing made it "four defeats" and "no wins" in oil industry cases it has tried in recent years. Which goes to prove just one point: When peeled of Washington politics and submitted to legal test, government-instigated trials without proper knowledge of industry economics result only in a shameful waste of millions of industry and taxpayer dollars.

Not only must the oil and gas industry answer false charges, it also must prove the fallacy of wasting millions of dollars conducting unnecessary studies and antitrust trials.

If our forefathers had wanted a federally controlled economy, they would have established it. What they did establish, a free economy, should be kept and nourished. It has done quite well for us so far.

Let us hope our federal government will exercise enough responsibility to ignore an industry that apparently feels it must run to Uncle Sam for help whenever it is being bested under free competition.

CONTROL CORROSION with WITTE Cathodic Protection Units



WITTE MODEL 98RBD engine-generator unit with standard 3 KW DC shunt-wound generator.

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4. 94 amp. at 32 volts
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9. Grease-packed sealed bearing

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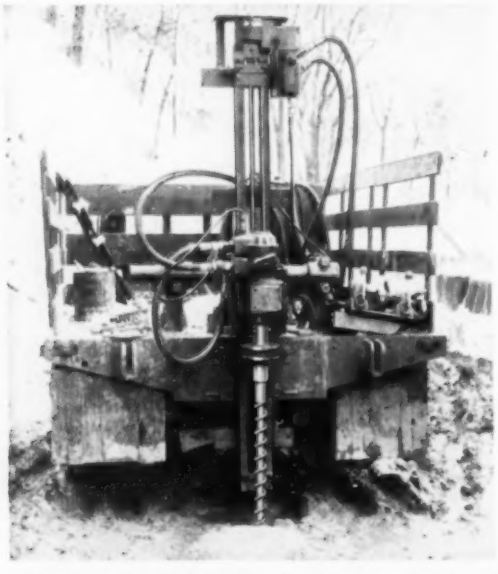

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PIPE LINE INDUSTRY and The PIPE LINE CATALOG for the oil and gas pipe line industry.

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PETROLEUM REFINER and The REFINERY CATALOG for the oil, gas and petrochemical processing industry.

Indexed by Engineering Index

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BRIEF SPECIFICATIONS

Bucket capacity, 2 cu. yd.; bucket reach, 50¾ in. (@ 7 ft. dump height); over-all width (bucket), 93½ in.; wheelbase, 88 in.; speeds, forward (4), 0-24 MPH . . . reverse (4), 0-30 MPH; shipping weight, with diesel engine, 20,780 lb. — with gasoline engine, 20,440 lb.

HIGH LIFT, extra-long reach and safety! Note how bucket lift arms are completely in front of operator's area. This gives him new freedom of movement and greater all-round visibility. Other safety features: wide steps for safe and easy access from either side. Plus wide fenders that provide a handy engine checking platform as well as protection for operator from rocks and mud.

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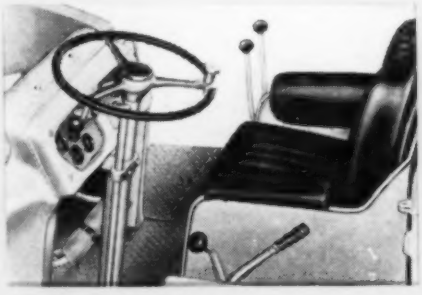
. . . the Cat wheel-type Traxcavator

. . . the first of a New Wheel Loader Line



DESIGNED FOR ACTION, controls provide instant, finger-tip shifting . . . a full range of work and travel speeds with reverse speeds 25% faster than forward speeds. Travel Range gives 2-wheel drive for roading . . . Work Range automatically puts power to all 4 wheels. Other action features: conveniently located machine and bucket controls . . . forward-reverse lever on the steering column . . . both bucket control levers with kick-out devices. Lift control releases at dumping height — tilt control positions bucket for digging.

DESIGNED FOR PRECISE CONTROL, the No. 944 brake system is outstanding. The left brake neutralizes the transmission as it stops the machine to provide superior loading action. The right brake leaves the transmission engaged for full control when creeping, etc.

VERSATILE IS THE WORD for the Cat No. 944 Traxcavator, which is offered with a full line of attachments and accessories to multiply its usefulness to you on any job. Available are forks, cab (shown here) and special buckets, including the exclusive side dump bucket.

Here's the first of a completely new line of equipment . . . the Cat No. 944 . . . rated at 2 cu. yd. capacity . . . that will soon include the No. 922 (1¼ cu. yd. bucket) and the No. 966 (2¾ cu. yd. bucket).

Watch for these new machines with the bold new design . . . they're ready to bring new standards to wheel loader operation. Take a look at the big new features that make this the easiest and fastest wheel loader to operate. Every feature is designed for *efficient work.* Plenty of horsepower . . . finger-tip steering . . . smooth, fast bucket action . . . outstanding operator comfort and safety.

Choose from two great new engines . . . the compact 4-cylinder Cat D330 Diesel Engine, turbocharged for maximum efficiency . . . or the 6-cylinder gasoline engine. Both are 105* HP units. Whatever your requirements, there's a No. 944 powered to meet your needs. Get the complete facts on the No. 944. See your Caterpillar Dealer the week of March 14. See for yourself how the new design pays off on your loader jobs!

Caterpillar Tractor Co., General Offices, Peoria, Ill., U. S. A.

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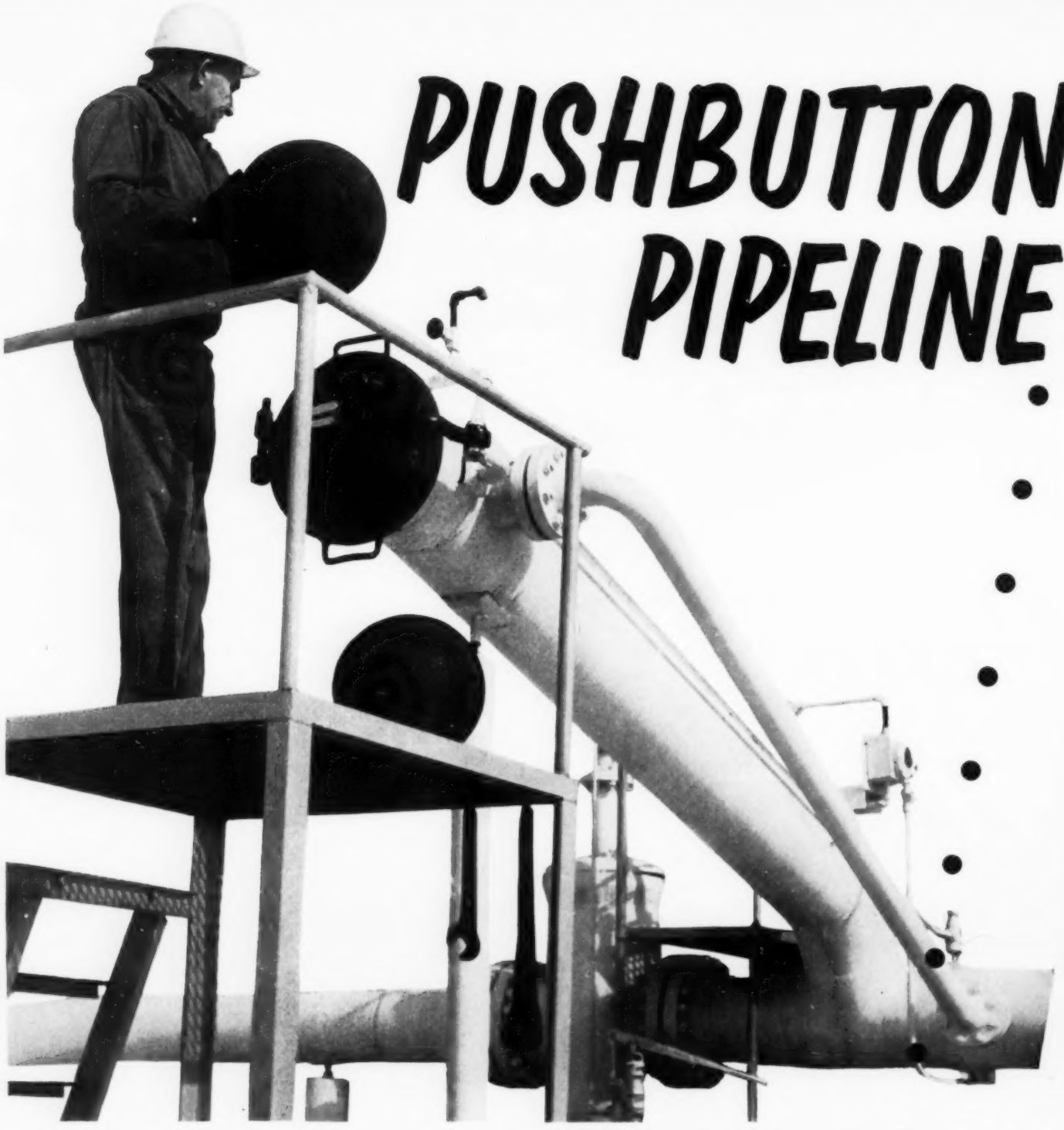

- This "magazine loading" launching barrel contains up to ten Pipe Line Spheres. After initial loading, a Sphere is launched with a push of a button. One or more succeeding Spheres can then be similarly launched at precise intervals as close as six seconds.
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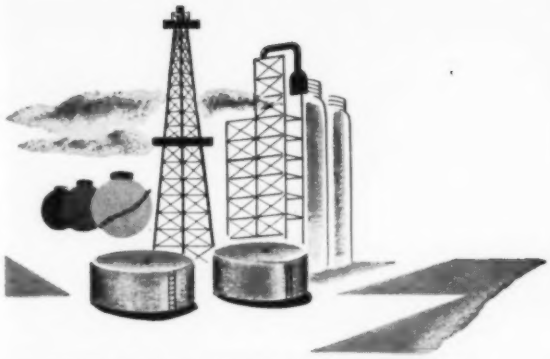

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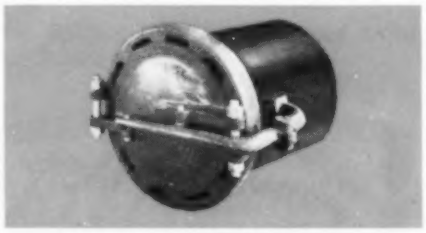
Unibolt hinged scraper traps are the answer

But not even a Unibolt Scraper Trap . . . with its easy-opening two-bolt coupling, its free-swinging hinged closure, its tight-sealing, long-lasting resilient gasket . . . can take all the work out of catching a pig. It comes mighty close, though, to making the job of starting and catching scrapers a trouble-free operation.

Unibolt originated the hinged closure to eliminate the troublesome, time-consuming multi-bolt blind flange. And the Unibolt self-sealing resilient gasket that remains in place when the closure is opened seldom, if ever, needs replacing. This saves you money as well as time. And a Unibolt Scraper Trap installed on an oversize barrel, the i.d. of which is slightly larger than the o.d. of the line, eliminates "fighting" the pig in and out of the trap. Line pressure does the heavy work.

The Unibolt Hinged Blowdown, or blowoff head, is an ideal companion to the Unibolt Scraper Trap on gas line service.

Complete details are carried in Bulletin PL-590, copies of which will gladly be sent on request.



A hinged type Unibolt Scraper Trap in closed position.

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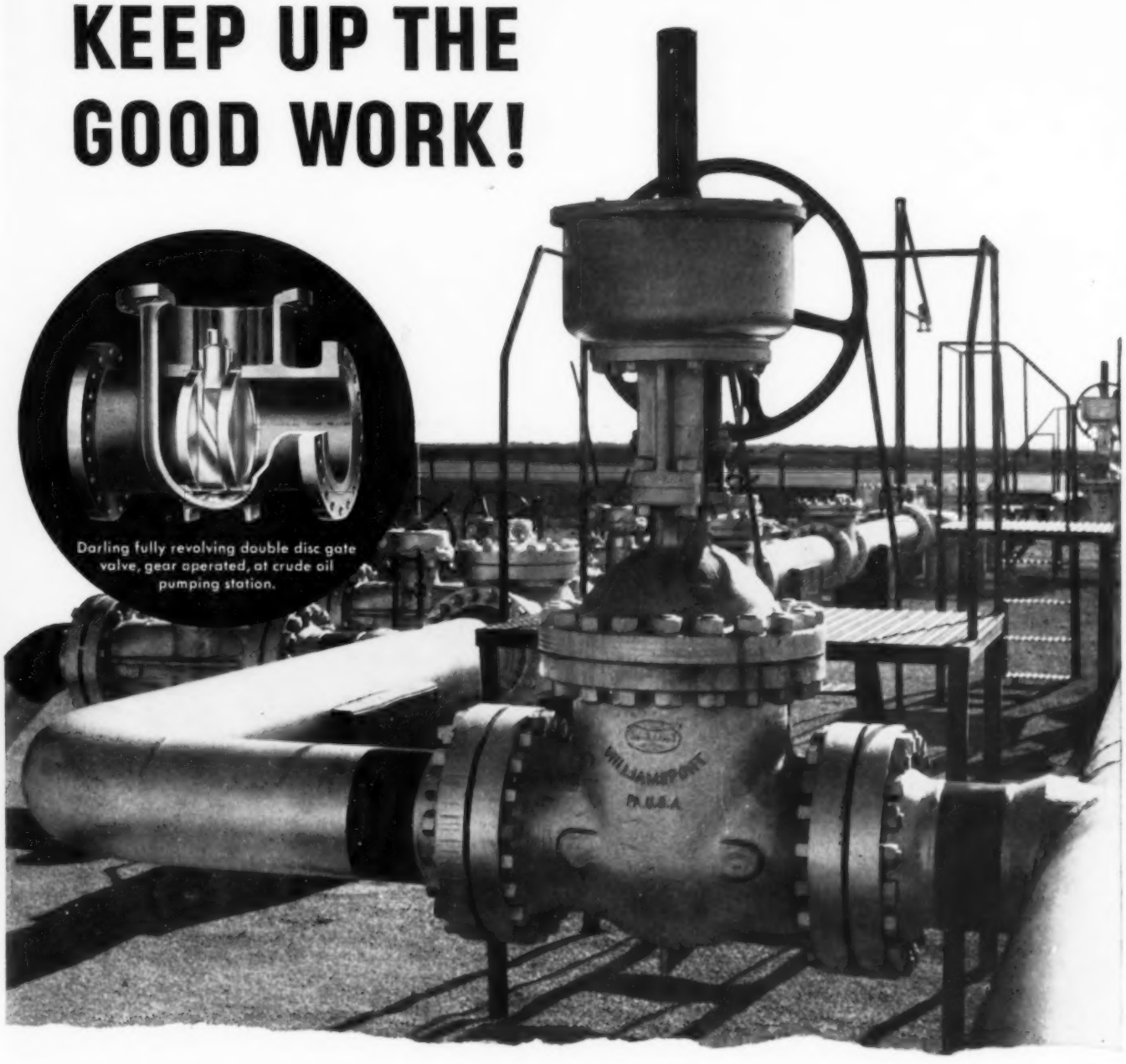
THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

This Darling gate valve feature can help you

KEEP UP THE GOOD WORK!



Darling fully revolving double disc gate valve, gear operated, at crude oil pumping station.

Almost all gate valves start out doing a good job. But it's very doubtful if *any* others can match Darlings for prolonged easy closure and freedom from downtime.

It's largely the Darling *fully revolving double discs with parallel seats* (shown above) that make the difference! This principle minimizes friction and uniformly distributes whatever wear there is. What's more these valves can "live" with the line stresses and surges that cause other valves to fail.

Why not get more familiar with how these Darling valves perform and what they offer you in avoiding trouble and downtime? Simply ask for Catalog No. 57.

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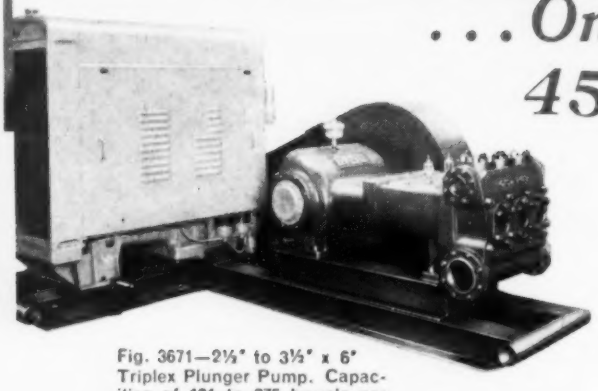

Fig. 3671—2½" to 3½" x 6" Triplex Plunger Pump. Capacities of 191 to 375 barrels per hour at working pressures from 1575 to 800 PSI.

No pump is stronger than the metal from which it is made, and no pump manufacturer casts his metal to more rigid specifications than Gaso. Here experienced foundry-men are preparing the mold for a Gaso power frame. Into it will be poured a special formula of molybdenum alloy cast iron. Test bars, sent regularly to a nationally known laboratory, consistently show a tensile strength of 45,000 to 48,000 lbs. per square inch. Another reason for the ruggedness of Gaso Pumps, their ability to withstand the shocks and strains of tough use, and their habit of outliving ordinary pumps . . . Latest catalog on request.

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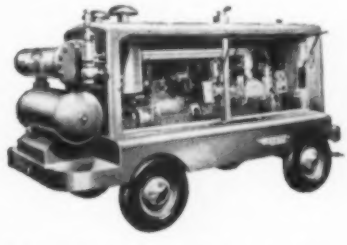
First fully efficient rotary compressor for pipeliners

Puts out full volume with same engine *running 100 rpm slower*

Other "600" rotary compressors produce 600 cfm of air at 100 psi when operating at 1800 rpm. The more efficient Jaeger Roto Air-Plus, using the same economical GM Diesel Model 6-71 engine, delivers the same volume at only 1700 rpm.

This difference in efficiency means that, throughout the longer life of your Jaeger compressor, you will produce air with less fuel, fewer feet of engine piston travel and up to 100 fewer revolutions of compressor vanes every minute of every working day. What's more, you'll find engine and compressor so closely regulated that air pressure remains constant under all normal demands.

For full details, check with your Jaeger distributor or write us for Catalog JCR-8. Find out why the Jaeger "Roto" is the top performer for today's top pipeline contractors.



Model "600". Equally efficient performance is offered in "365" and smaller sizes.

The Jaeger Machine Company, 665 Dublin Avenue, Columbus 16, Ohio. Sales, Rentals, Service in over 150 Cities of U. S. and Canada

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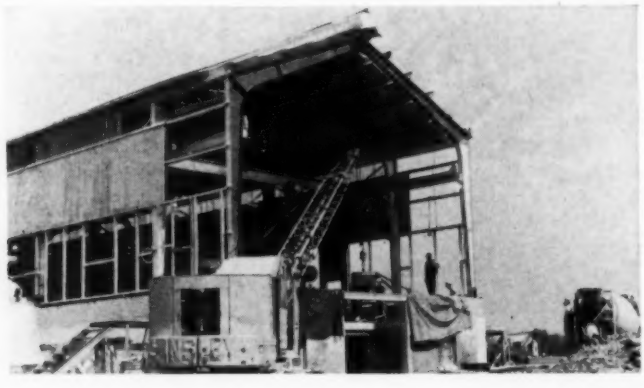

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In addition to pipe lines *LATEX* offers an experienced organization for STATION CONSTRUCTION AND ALLIED WORK.

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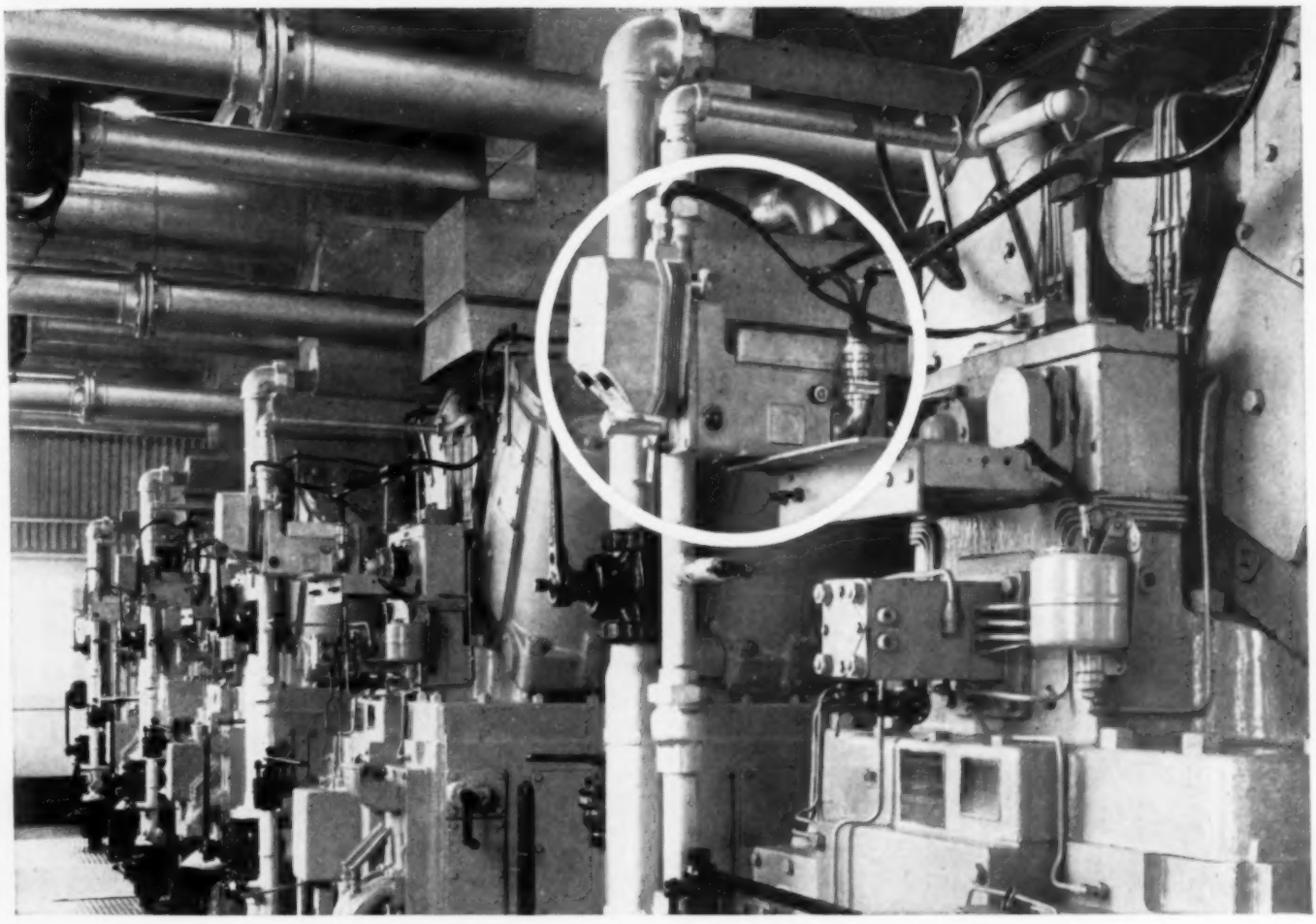

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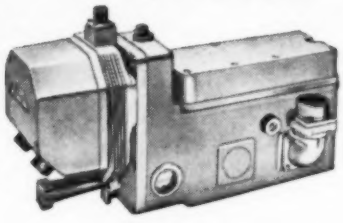
designed specifically for natural gas and petroleum industries

Hi-V Coil



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A MATCHED IGNITION SYSTEM

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2. Simplified maintenance
3. Longer spark plug life
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6. High voltage output
7. Matched ignition system
8. Single or dual ignition
9. Flameproof
10. Low maintenance costs
11. For engines of 6 through 16 cylinders

At the installation shown here, DLC Ignition unfalteringly performs its function in aiding with the preparation of natural gas for consumer use.

Bendix* DLC Ignition is the result of the most modern engineering design, and incorporates the latest developments in ignition materials. That's why it meets the most exacting requirements of modern high-compression engines used by the natural gas and petroleum industries.

Because DLC Magneto and Hi-V Transformer Coils form a matched ignition system, it delivers ample voltage while, at the same time, assuring reduced maintenance costs.

If you want facts on why important operators specify Bendix DLC Ignition, write: SCINTILLA DIVISION, BENDIX AVIATION CORPORATION, SIDNEY, NEW YORK. *REG. U.S. PAT. OFF.

Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y. *Canadian Affiliate:* Aviation Electric Ltd., 200 Laurentien Blvd., Montreal 9, Quebec. *Factory Branch Offices:* Burbank, Calif.; Orlando, Florida; Chicago, Ill.; Teaneck, New Jersey; Dallas, Texas; Seattle, Washington; Washington, D. C.

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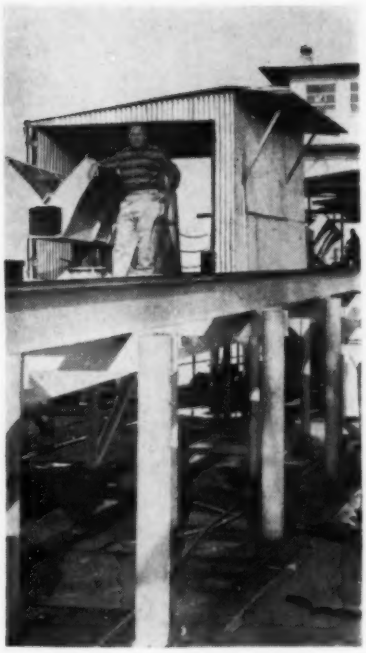

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With Carline, achievement means growth. Sam Carline, Inc. has a network of achievement in the Deep South. Its 260 foot multimillion dollar offshore lay barge shown, is the latest expansion move. Capable of quartering 84 crewmen, the reconditioned Navy YF has recreation facilities, 2 - 35 ton stiffleg derricks and is capable of operating in 150 feet of water.

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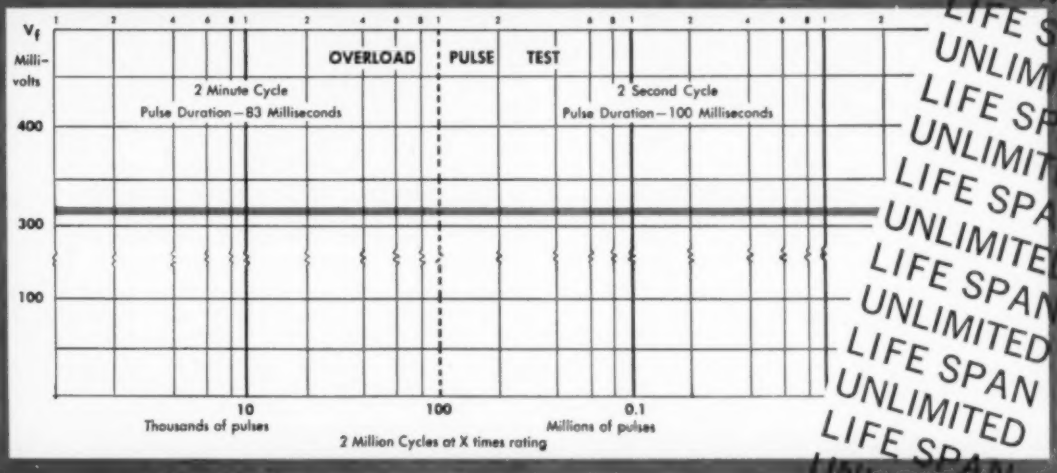
The only Selenium Rectifier Stack with no artificial barrier layer

ANOTHER ACHIEVEMENT OF GENERAL INSTRUMENT CORPORATION

RADIO RECEPTOR

Tri-Amp



UNLIMITED LIFE SPAN

visible proof of Tri-Amp's unlimited life span

Day after day this life test continues in the Radio Receptor laboratories—with surge currents ten to fifteen times the rating of ordinary rectifiers! *Ordinary* cells deteriorate when run within rated limits, but Tri-Amp operates at these high current densities without detectable signs of deterioration due to age and usage.

And these results are not confined to tests—in actual performance Tri-Amp proves again and again it is one of the most effective forms of rectification available to modern industry! It has a true P-N junction formed by a closely controlled diffusion process involving the use of cadmium-selenide and tellurium. We'll be glad to send you more complete information on this important development. Write today to Section PL-3

CHECK LIST OF Tri-Amp SUPERIORITY

- Better overload characteristics.
- High current ratings.
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- No special protective devices required.
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- Operate in parallel or in series without special precautions.

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AUTOMATIC MANUFACTURING

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FOUR OF THE WORLD'S BEST OIL RINGS!

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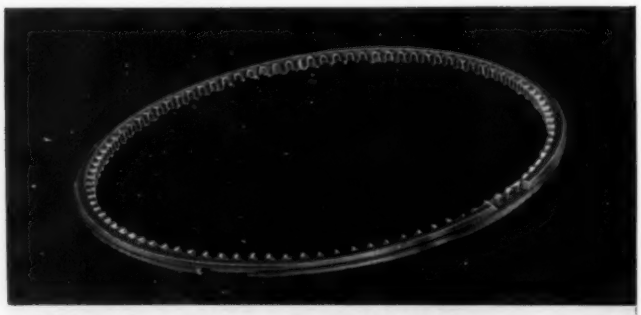
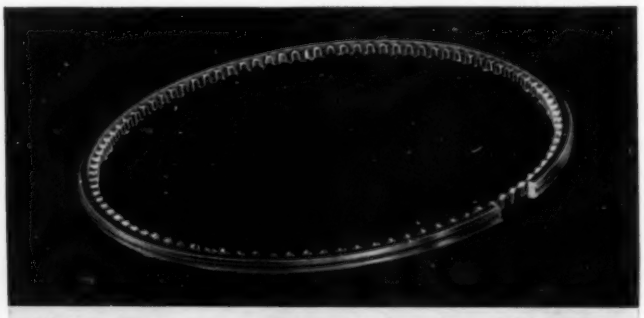
Each is a Pedrick FORMFLEX design, with the exclusive "Equalizer", an abutment-type expander which exerts a uniform controlled pressure. The ring sections are radially thinner and more flexible, and thus are more conformable than any other rings! Scuffing is eliminated, oil control is improved, wear is reduced, power is preserved, and efficient operation is assured for more engine hours.



DO8—Because there are *two* radially-thinner cast-iron sections which move independently of each other, this ring achieves *maximum* conformability and drainage. Each cast-iron piece has directional bevel and an undercut edge as well as drainage slots underneath. Unequalled in performance.



DD8—Provides maximum radial conformability and drainage under both scraping edges. Is somewhat lower in cost than the DO8 because of one-piece instead of two-piece construction of cast-iron section.

HO8—Maximum conformability and adequate drainage, with continuous channel, two scraping edges and wide central drainage slots for effective oil control. First cost is less than either DO8 or DD8.

BS8—This conformable ring combines compression and oil control functions. Backed by the "Equalizer," the solid single-piece cast-iron section has a narrow scraping edge and is especially effective in controlling blow-down and oil consumption in 2-cycle engines.

Our engineers will be glad to discuss with you, the proper application of Pedrick's FORMFLEX oil rings. Phone, wire or write to Wilkening Manufacturing Co., Philadelphia 42, Pa. Saratoga 9-3770. In Canada: Wilkening Manufacturing Co. (Canada) Ltd., Toronto 2.

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OFFERING A FULL LINE OF TOP-QUALITY RINGS—ALL SIZES, ALL DESIGNS

PIPE LINE PANORAMA

Internal Coating Trend Sparks Manufacturers' Interest . . . In recent weeks, three manufacturers have announced new internal cleaning and coating systems —another will be introduced in near future. Latest developments:

Klean-Kote system uses gas turbine to sand blast pipe walls. Sand propelled and suspended by air stream produces pore penetration, followed by surface polishing. In recent demonstration, three miles of buried 6-inch line were cleaned in two hours.

Crose-Perrault's internal cleaning and coating machine, for 16-36 inch pipe, uses high speed circular wire brush with continuous operation vacuum pickup system. Airless coating spray system uses hydrostatic pressure to atomize paint, eliminating 90 percent of overspray and coating bounce-back. Electric-driven machine is mounted on boom car for accessibility, rapid operation and portability. Four men can operate machine, designed for yard operations.

Rosson-Richards' new system includes either wet abrasive or wirebrush cleaning machine, coating machine, plus a mil thickness and holiday detector. (See January PIPE LINE INDUSTRY, Page 48). Electronic detector is contained in a pig that is put through line day after coating has been applied. Designers say it can accurately measure coating thickness to 1/5 mil and locate holidays.

What Pipeliners Will Discuss at API Meeting . . . Transportation Division of American Petroleum Institute will present following papers and panel sessions at Tulsa, April 28-29: Automation and instrumentation—right-of-way problems —future of pipe line industry—offshore pipe lines and marine terminals—dispatching and scheduling—automation panel covering economic and industrial relations aspects, progress pipe line industry has made in automation.

Pipe Line Panorama . . . Natural gas industry is now wondering whether Federal Power Commission controls will extend to intrastate transport of gas through interstate lines. Reason: Recent FPC decision to exert jurisdiction on Oklahoma Natural Gas Company proposal to take Oklahoma produced gas and sell it in Oklahoma, from pipe line that extends from Shamrock, Texas, to Wichita, Kansas. Whether this is isolated case or will become common practice is still a moot question . . . **Two aluminum gas lines were recently completed.** Mile-long, six-inch line links Louisiana well with Columbia Gulf's gathering system; 1,600 feet of 4-14 inch seamless aboveground line is now providing Kaiser alumina plant in Baton Rouge, La., with 50 MMcf gas daily from Olin Gas Transmission's system . . . **Pacific Lighting Gas Supply's new 116-mile 34-inch line from Newberry, California to connect with Transwestern's system at California-Arizona border will have several new cost-cutting innovations,** i.e., double jointed in the yard—being coated with coal tar enamel delivered hot from plant 125 miles away—welded by bell hole method in the ditch. Also, line will operate "hot",—will have minimum sags and overbends.

Will Secondary Boycotts be Legalized? . . . House Education and Labor subcommittee has been conducting hearings on first legislative move to weaken Landrum-Griffin Labor Reform Bill. Proposal asks that secondary boycotts be legalized at building sites.

Bureau of Labor Statistics reports that negotiations completed in recent years will result in a minimum 15-cent increase for 66 percent of U.S. construction workers in 1960. Only 15 percent will receive less than 11-cent increases, and some will get 22 cents.

Planning the Corrosion Control Program

Why not combine corrosion control field work with other instrumentation field tasks such as measurement? Both are based on ability to handle instrumentation. Also this will improve efficiency by reducing percentage of time spent in traveling

By Pat H. Miller
Superintendent of Gas Measurements and Corrosion Control, Texas Eastern Transmission Corporation, Shreveport, La.

WHY NOT COMBINE all instrumentation work into a single department to simplify and increase the efficiency of several phases of gas transmission system operations?

There are two ways the corrosion control activities of a large gas company can be organized: First, corrosion work can be carried out by a specialized corrosion control department. Second, this work can be carried out as one of several objectives of a general instrumentation department made up of various technical sections whose results basically depend on instrumentation.

Both systems are successful. However, the latter method may offer the greatest opportunity for economy and efficiency. After all, the theory of all instrumentation is fundamentally related, and it is certainly possible to employ men with sufficiently versatile training and aptitude to implement the techniques of instrumentation in the broadest sense.

Given the appropriate incentives, proper clarification of duties, adequate tools and instruments and a continuous training, such men can handle any combination of instrumentation problems—one as well as another. **Diversification does not appear to reduce the efficiency of a really qualified instrument engineer.**

On a long transmission system, a field engineer whose only duties are to handle corrosion problems, must be assigned to a widely spread territory and a very large portion of the average working day is spent going to and from work locations. The accomplishments of this engineer can be increased when his activities are confined to a smaller area where his duties are diversified to the extent that he handles two or more activities such as corrosion control, gas measurement, quality control and possibly communications in addition to servicing the instruments used by the other departments of the company. Such an arrangement permits the employe to work close to home. This results in better family life.

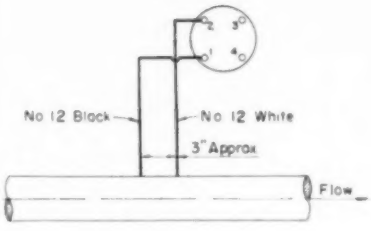
The Texas Eastern Transmission Corp. Measurement Department is in effect a general instrumentation department. In addition to having the responsibility for gas measurement, gas accounting, quality control and corrosion control, this department acts as a general service unit maintaining pneumatic instruments and conducting tests for other departments. The effectiveness of this method of operation is reflected in the results of our corrosion control program. *We run two complete corrosion surveys each year on every bit of our system consisting of over 6,000 miles of high pressure natural gas transmission lines and related structures.* The same instrument engineers accomplish all necessary trouble shooting on existing corrosion control facilities and supervise the installation of supplementary corrosion control facilities as well as handle the gas measurement, pressure regulation volume control and miscellaneous pneumatic instrumentation work. The fact that each man's work is concentrated removes the need for driving appreciable distances between installations and prevents having similarly qualified technicians traveling the same area.

AIMS OF A CORROSION CONTROL DEPARTMENT

History shows that a multiplicity of leaks and blowouts generally result when effective corrosion control measures are not taken. Costs of service interruptions, leakage losses and costs of repairs have proven great enough to impair earnings of some companies in the past. So, there is little question as to the value and great importance of an effective corrosion control program.

Briefly, here is a summary of Texas Eastern's corrosion control program:

Our purpose is to protect all operating facilities of the company from



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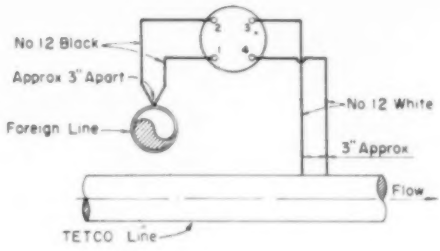
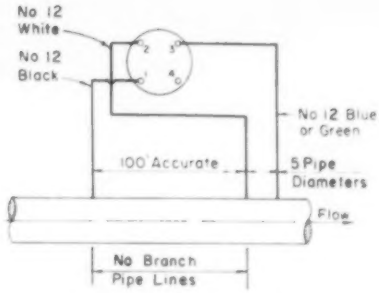
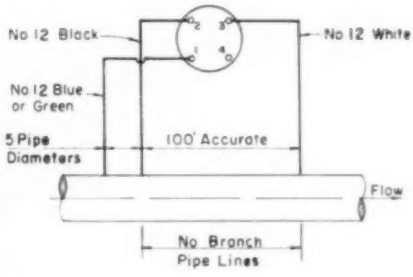


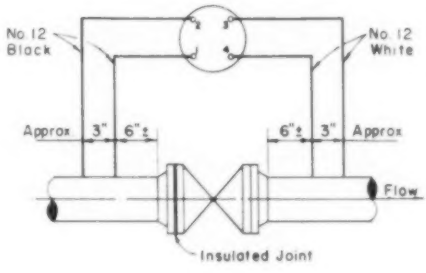
LINE CROSSING TYPE "F"



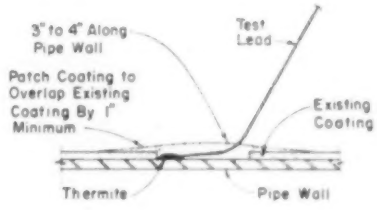
CALIBRATING TYPE "CA"



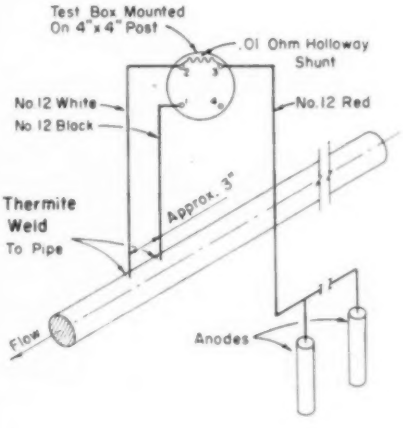
CALIBRATING TYPE "CA" ALTERNATE



INSULATED JOINT TYPE "I"



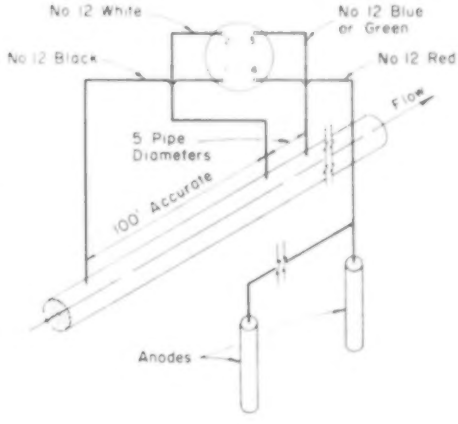
TYPICAL WIRE ATTACHMENT



TYPICAL ANODE & TEST SITE INSTALLATION

GENERAL NOTES

1. Wire shall have sufficient slack to allow for any pipe movement.
2. All wire shall be at least 20 inches under ground surface.
3. All wire shall be No. 12 solid copper, plastic covered, type TW.
4. Terminal box shall be Condulet GR 28 with threaded cover, gasket No. GASK 314 and connection block CB 302.
5. Wires shall be connected to the numbered terminals on connection block as shown for each type test site. Note flow direction when connecting wires.
6. Screw down threaded cover till snug and then stamp onto cover tightening boss the proper identifying letters as given in table.
7. All lead wire shall be tied to temporary post until permanent post has been installed.



CALIBRATED SITE WITH ANODES

TYPE "GCA"

Schematic Standards for Pipe Line Corrosion control.

deterioration caused by corrosion and to apply corrosion control measures to all company facilities both above and below ground.

To apply such protection in sufficient time to avoid excessive maintenance costs, line losses, service interruptions and intangible costs which result from pipe line failures due to corrosion.

To sell the merits of corrosion control to the pipe line maintenance crews and others in order to have their cooperation and assistance in carrying out the corrosion control program.

To teach the fundamentals of corrosion and corrosion control to all affected parties so that they may realize the importance of the program to the healthy growth of the company so they will lend assistance to the program.

To cooperate with other operating companies to avoid creating conditions which might cause corrosion to one another's facilities.

To keep other interested departments and the management informed as to work accomplished, the condition of the property in regard to corrosion, and in regard to the costs of the program.

We have found that the best way to be sure that each activity in any program is taken care of at the right time is to have all items which should enter into the consideration set out

TABLE 1—What Corrosion Control Costs

Pipe Line Section No.	Size of Pipe	Miles of Pipe In Service	Number of Rectifiers In Service	Number of Galvanic Anodes	Number of Test Sites	Accumulated Investment In Corrosion Control Facilities		Operating Expense				Corrosion Operating Expense Per Mile	
						Total	Average Per Mile	S & E Charges		Labor	Total	1958	1957
								Power	Other				
1	16	146.97	4	69	203	$ 21,515	$ 146.39	$ 215.80	$ 2,309.97	$ 3,004.48	$ 5,530.25	$ 37.63	$ 12.84
2	16, 20, 30	119.71	3	8	227	13,786	115.16	49.53	638.19	1,624.33	2,312.05	19.31	6.02
3	16, 20, 30	118.69	4	24	210	17,878	150.63	167.43	340.77	863.80	1,372.00	11.56	8.63
4	20	86.27	1	36	114	5,716	66.26	51.75	496.31	496.47	1,044.53	12.11	9.45
7	20	91.61	3	8	124	10,472	114.31	77.97	197.24	703.79	979.00	10.69	7.08
10	24	67.45	2	...	67	5,290	78.43	112.58	308.46	1,039.93	1,460.97	21.66	16.07
11	24	61.98	3	...	47	7,940	128.11	177.24	510.83	544.64	1,232.71	19.89	17.91
12	24	61.86	2	...	42	5,290	85.16	120.00	463.12	497.88	1,081.00	17.47	15.65
13	24	60.42	3	...	36	9,612	159.09	215.78	582.82	763 18	1,561.78	25.85	15.86
14	24	96.77	2	15	97	8,025	82.93	112.10	684.13	2,048.47	2,844.70	29.40	26.38
15	24	104.19	...	41	162	4,640	44.53	.....	1,028.92	2,157.41	3,186.33	30.58	14.18
16	24	53.10	3	13	45	8,640	162.71	232.85	1,783.87	1,357.90	3,374.62	63.55	46.25
17	24	53.39	3	39	34	9,196	172.24	343.72	1,107.74	765.82	2,217.28	41.53	21.70
18	24	63.68	3	17	33	12,488	196.11	256.96	751.73	647.01	1,655.70	26.00	34.88
19	20, 24	109.87	5	23	58	7,199	65.52	399.64	604.48	582.67	1,586.79	14.44	44.34
20	20, 24	109.40	6	12	42	17,261	157.78	1,059.27	3,181.18	2,389.54	6,629.99	60.60	33.76
21	20, 24	115.26	5	...	49	6,887	59.75	388.93	1,241.85	763.98	2,394.76	20.78	17.40
22	20, 24	107.42	6	5	49	14,744	137.26	722.82	1,234.09	1,522.63	3,479.54	32.39	17.75
23	20, 24	91.00	8	48	47	29,397	323.04	629.00	1,837.34	1,350.92	3,817.26	41.95	34.90
24	20, 24	107.37	5	2	56	17,376	161.83	740.62	1,174.62	1,390.46	3,305.70	30.79	28.60
25	20, 24	114.41	4	17	54	12,438	108.71	173.41	846.32	772.17	1,791.90	15.66	12.36
26	20, 24	85.65	4	17	37	11,078	129.34	334.22	280.78	386.67	1,001.67	11.69	20.71
27	20, 24	117.80	6	8	54	12,425	105.48	140.73	396.27	503.41	1,040.41	8.83	21.92
28	20, 24	82.95	6	3	37	20,492	247.04	281.11	169.53	339.72	790.36	9.53	35.29
29	20, 24	109.39	6	...	40	20,493	187.34	318.17	276.11	513.20	1,107.48	10.12	17.70
30	20, 24, 26	173.19	7	...	96	26,390	152.38	364.81	340.76	820.94	1,526.51	8.81	10.79
31	20, 24, 26	144.40	15	1,390	215	128,486	889.79	3,468.57	928.77	1,526.45	5,923.79	41.02	54.03
32	20, 24, 26	135.73	37	2,487	374	383,597	2,826.18	5,555.86	1,068.89	2,660.27	9,285.02	68.41	66.38
33	20, 24, 26	125.42	27	17	235	251,585	2,005.94	7,377.98	2,120.04	3,306.23	12,804.25	102.09	109.46
34	20, 24	80.66	14	10	238	138,752	1,720.21	4,404.40	2,144.25	3,011.29	9,559.94	118.52	98.38
35	20, 24	117.85	14	...	96	62,766	532.59	4,619.80	988.00	1,332.00	6,939.80	58.89	69.78
36	20, 24	98.88	11	...	52	51,642	522.27	3,046.33	664.79	1,326.15	5,037.27	50.94	19.58
37	20, 24	122.91	15	...	108	61,594	501.13	5,435.94	1,452.07	2,945.85	9,833.86	80.01	105.48
38	20, 24	134.64	8	26	169	37,485	278.41	1,404.95	2,547.04	6,720.71	10,672.70	79.27	59.69
39	20	147.59	2	88	246	41,866	283.66	181.46	1,454.70	3,675.16	5,311.32	35.99	29.22
40	20	103.71	9	612	232	103,536	998.32	1,396.11	1,932.24	7,811.60	11,139.95	107.41	118.92
41	30	182.84	3	18	146	22,677	124.02	266.72	933.31	1,379.17	2,579.20	14.11	7.05
42	30	143.91	2	2	104	11,206	77.87	207.11	589.66	764.09	1,560.86	10.85	9.12
43	30	145.46	4	7	121	18,866	129.70	113.60	863.66	1,057.99	2,035.25	13.99	8.55
44	30	127.16	2	6	117	14,346	112.82	35.28	406.44	409.33	851.05	6.69	10.13
45	30	129.86	4	27	114	25,073	193.08	209.80	399.36	911.53	1,520.69	11.71	8.76
46	30	150.74	2	1	92	15,956	105.85	357.21	549.85	636.81	1,543.87	10.24	15.30
47	30	150.68	4	5	123	28,882	191.68	348.56	753.94	1,179.94	2,282.44	15.15	11.15
48	30	123.13	2	2	96	12,221	99.25	189.57	977.60	904.99	2,072.16	16.83	15.04
49	30	95.57	2	25	77	31,762	332.34	274.02	460.19	606.89	1,341.10	14.03	10.01
50	30	122.82	2	8	144	14,032	114.25	243.93	524.50	883.20	1,651.63	13.45	12.20
51	30	78.23	1	10	130	10,587	135.33	48.98	989.19	1,156.90	2,195.07	28.06	15.68
52	30	77.24	...	2	286	14,853	192.30	132.11	265.80	1,357.84	1,755.75	22.73	16.65
53	30	34.68	2	...	81	33,934	978.49	216.44	426.39	950.34	1,587.17	45.77	50.38
54	24	55.16	7	16	118	127,981	2,320.18	269.88	889.29	2,426.12	3,519.29	63.80	70.24
55	24	56.32	..	74	66	24,019	426.47	.....	101.65	354.36	456.01	8.10	56.96
56	24	55.88	1	98	68	16,018	287.19	98.20	411.92	603.72	1,113.84	19.93	39.36
57	24	58.03	2	68	99	17,095	294.59	120.41	788.90	1,747.06	2,656.37	45.78	39.61
58	24, 30	52.34	1	30	108	11,152	213.07	45.36	351.82	994.53	1,391.71	26.59	21.93
59	16, 20	60.22	1	42	106	17,358	288.24	83.86	526.80	1,332.57	1,943.23	32.27	28.57
60	30	64.63	2	16	92	11,147	172.47	.....	558.40	1,590.11	2,148.51	33.24	20.54
61	30	62.74	2	...	151	6,981	111.27	25.57	481.67	447.24	954.48	15.21	14.08
62	30	63.82	4	...	51	12,251	191.96	176.73	922.28	999.18	2,098.19	32.88	23.33
63	30	63.85	1	...	39	6,734	105.47	140.81	314.50	344.45	799.76	12.53	20.08
64	30	64.34	2	...	46	8,914	138.55	100.85	457.57	785.02	1,253.44	19.48	21.40
65	30	58.93	2	...	52	7,611	129.15	84.74	462.99	447.64	995.37	16.89	20.69
66	30	46.55	2	...	89	5,713	122.73	9.35	30.08	72.50	111.93	2.40	.20
67	30	100.48	3	28	203	21,496	213.93	113.56	427.53	1,034.50	1,575.59	15.68	2.61
68	30	163.45	5	42	237	34,990	214.07	54.10	795.16	1,328.87	2,178.13	13.33	.70
69	30	117.62	5	67	322	25,170	213.99	304.55	477.91	1,414.93	2,197.39	18.68	.38
70	30	57.26	4	85	48	12,251	213.95	72.16	274.40	374.70	721.26	12.60	...
71	30	62.82	2	...	85	13,440	213 94	17.48	108.85	161.87	288.20	4.59	5.10
72	30	55.10	2	47	142	11,797	214.10	33.47	396.83	798.27	1,228.57	22.30	2.68
Microwave Towers	.....	.....	...	211	...	8,090	.....	.....	.....	.....	.....	.....	.....
General Expenses	.....	.....	...	...	...	.....	.....	.....	12,398.85	28,858.53	41,257.38	6.25	5.65
Totals–December 31, 1958	.....	6,603.45[3]	334	5,972	7,778	$2,237,075	$ 338.77	$48,912.55	$67,399.51	$120,476.32	$236,788.38	$ 35.86[1]	$ 32.72[1]
Totals–December 31, 1957	.....	6,798.50	308	5,700	[4]	1,993,204	293.18	47,611.21	64,848.95	109,991.85	222,452.01	32.72	41.75[2]
Change During 1958	.....	−195.05	+26	+272	...	+243,871	+45.59	+1,301.34	+2,550.56	+10,484.47	+14,336.37	+3.14	−9.03

[1] Total Corrosion Control operating expenses divided by miles of pipe in service for respective years.
[2] Total Corrosion Control operating expenses for 1956 divided by mile of pipe in service December 31, 1956
[3] Total miles of pipe in Gas Service and paralleling Product service, December 31, 1958.
[4] This item not included in 1957 Report.

Cost of Coating	$23,517,430
Cost of Test Facilities	194,450
Cost of Cathodic Protection Installations	2,237,075
Total Invested in Corrosion Facilities	$25,948,955

in chronological order in a procedures manual. The following check list was taken from the corrosion control section of our procedures manual.

CHECK LIST OF FUNCTIONS OF A CORROSION CONTROL DEPARTMENT

I. New pipe line construction phase of corrosion control functions.

1. Protective coatings

A. Selection of materials and methods (based on terrain)
(Example:)
(1) Moderate terrain
a. pipe cleaning (accepted practice)
b. primer (mfgrs. specifications)
c. hot applied coating
1. coal tar
2. other
d. fiber glass reinforcement
e. outer wrap
1. felt
2. other
f. application
1. mill yard
2. rail head
3. over the ditch
(2) Rugged and rocky terrain
(3) Creek and river crossings
(4) Swampy and marshy terrain and bay crossings
(5) Compressor station discharge hot lines
(6) Built up and highly corrosive areas
(7) Plant piping areas and miscellaneous small lines
(8) Tie-in welds

B. Inspection of materials and workmanship.
(1) Visual
a. pipe cleaning

b. equipment
c. temperatures
1. coating
2. atmospheric
d. coating thickness
e. bond
f. general conditions
(2) Electrical
a. above ditch—"Jeep" holiday detector

2. Insulated joints
A. Interconnection points
(1) Suppliers system
(2) Customers system
(3) Company lateral lines and interconnections
(4) Plants
Provide insulated joints with resistance type electrical bonds to control current drainage where necessary

3. Test facilities
A. Standard two wire test site
B. Calibrated test site (100 foot drop)
C. Foreign line test site
D. Insulated joint test site
E. Experimental test site

4. Preliminary tests of initial corrosion control facilities
A. Holiday detector test after burial of pipe line
B. Coating resistivity test
C. Casing test
D. Insulated joint test
E. Test sites

5. Repair of unacceptable workmanship

6. Retests and acceptance

II. Initial cathodic protection phase of corrosion control Preparations

1. Basic tests (initial corrosion control survey)
A. Pipe-to-soil potential test (copper sulfate electrode)
B. Current flow test
C. Foreign line test
D. Surface potential test (bare lines)

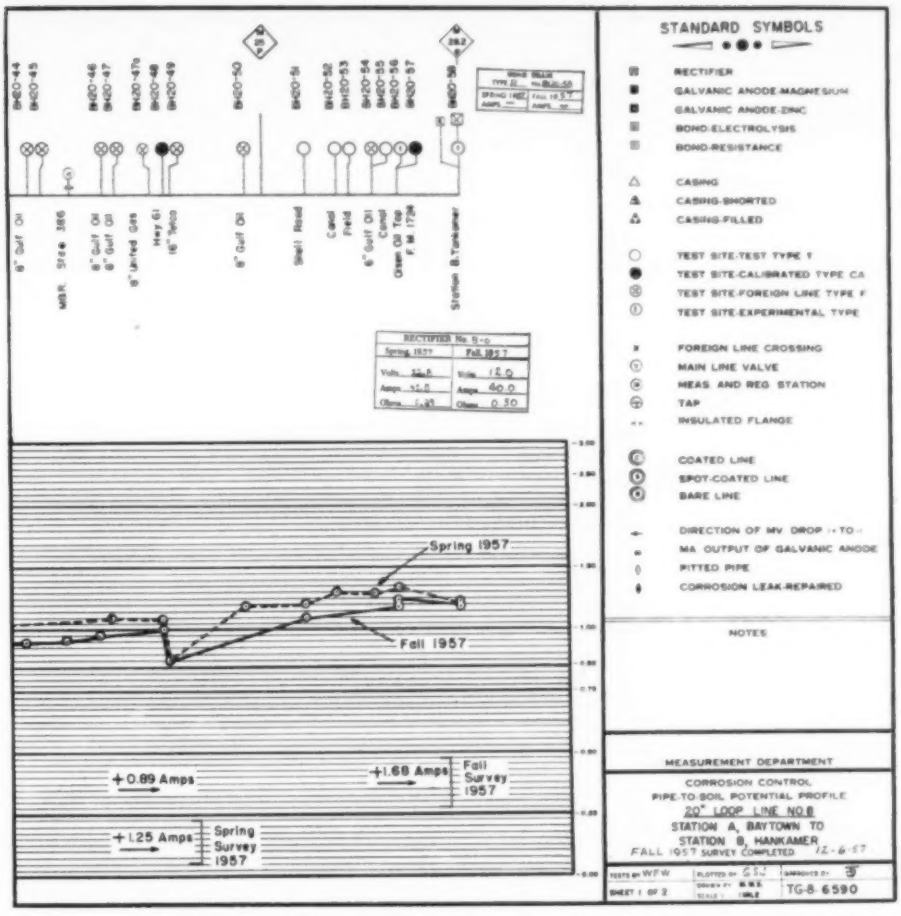
2. Analysis of basic tests
A. Plotting profiles
B. Preliminary recommendations and discussions

3. Test for design of cathodic protection facilities (from initial survey)
A. Soil resistivity test
B. Current requirement test
C. Foreign line interference test

4. Other considerations
A. Availability of power supply
B. Rights-of-way
C. Accessibility

5. Summary
A. Calculations
B. Conclusions
C. General recommendations and discussions

6. Selection of cathodic protection facilities
A. Rectifier—ground bed
(1) Remote beds
(2) Parallel beds
(3) Distributed beds
(4) Deep well beds



Form for plotting pipe-to-soil potential profiles. The changes for the worse are easily spotted.

B. Galvanic anodes
(1) Magnesium
(2) Zinc
C. Resistance bonds
(1) To foreign lines
(2) To company owned structures
D. Electrolysis bonds (stray currents)
(1) Low resistance drainage bond
(2) Reversing switches
E. Cost comparisons (see cost summary)
F. Conclusions
G. Preliminary sketches
H. Recommendations

7. Discussions and understandings and decisions
A. Management clearance
B. Design and installation drawings

III. Application of cathodic protection

1. Preparation of proposed work order
A. Location
B. Purpose and necessity
C. Cost estimate
(1) Material
(2) Labor
(3) Special work equipment
(4) Rights-of-way
(5) Fixed and overhead charges, etc.

Note: Our obligation in regard to the work order does not end when it is submitted. We follow it through in order to expedite processing if necessary.

2. Approved work order implementation
A. Material procurement
(1) Materials on hand
(2) New material
B. Rights-of-way
C. Contracts
(1) Power supply
(2) Construction (if outside help is required)

3. Construction of cathodic protection facilities (expedite)

4. Preliminary adjustments and turn on (expedite)

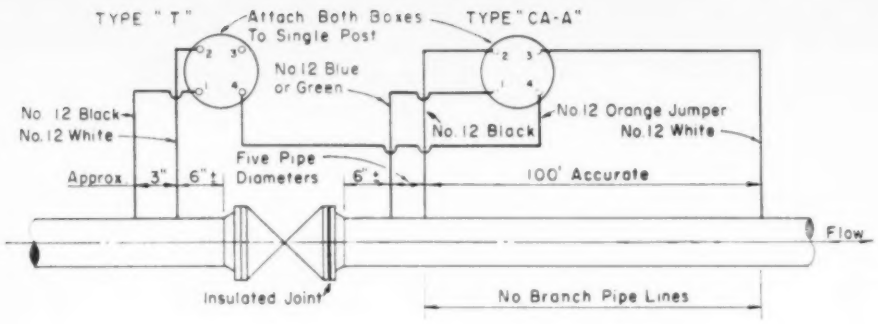
5. Test effectiveness of cathodic protection

A. Pipe-to-soil potential test

B. Current flow test

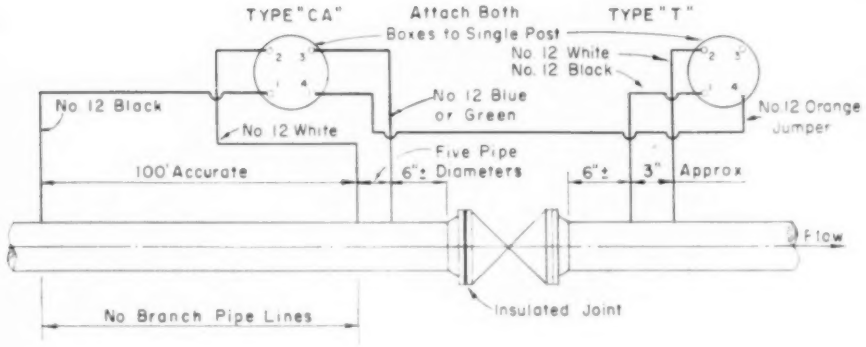
C. Rectifier—ground bed
(1) Current output
(2) Circuit resistance
(3) Efficiency
(4) Anticipated ground bed life

D. Foreign line test
(1) Bond resistance
(2) Current drainage



ALTERNATE ARRANGEMENT

CALIBRATED INSULATED JOINT TYPE "CA-I-A"



NORMAL ARRANGEMENT

CALIBRATED INSULATED JOINT TYPE "CA-I"

Two arrangements of calibrated insulated joints. Note: if 100 feet of pipe without branch lines, blowoff stacks, taps or change in wall thickness is not available, the distance shall be as great as possible.

E. Galvanic anodes
   (1) Current output
   (2) Anticipated life
F. Electrolysis bond test
   (1) Average current drain
   (2) Ground voltages
   (3) Foreign line intereference test

When these tests are completed and the necessary adjustments indicated by them have been made the new pipe line and the corrosion control facilities on them are taken into the long range corrosion control maintenance program, which is the third major phase of corrosion control.

IV. Long range maintenance program. Routine Field Inspections, Tests and Surveys

1. Monthly rectifier inspection
   A. Power consumption
   B. Rectifier efficiency
   C. Circuit resistance
   D. Pipe-to-soil potential tests at rectifier

2. Monthly electroylsis bond inspection

3. Semi-annual corrosion control survey
   A. Pipe-to-soil potential tests (copper sulphate electrode)
      (1) Pipe line (test sites)
      (2) Exposed taps
      (3) Casings
      (4) Main line valves
      (5) Foreign line crossings
      (6) Microwave tower anchor rods
      (7) Plant piping and other metallic structures
   B. Current flow (calibrated test sites)
   C. Bond drainage
      (1) Electrolysis
      (2) Resistance
   D. Galvanic anode current outputs
   E. Rectifier readings
      (1) Voltage
      (2) Current output
      (3) Circuit resistance

4. Pipe line and Coating inspections
   A. To be made wherever normally buried pipe is excavated or otherwise exposed
      (1) Taps
      (2) Line breaks
      (3) Leaks
      (4) Casings
      (5) Pipe line washes
      (6) Plant piping excavations
      (7) M & R station piping excavations
      (8) Other

V. Check list for corrosion facilities maintenance (repairs, alterations and additions)

1. Repair and adjust existing cathodic protection facilities

2. Revise and replace existing cathodic protection facilities

3. Repair shorted casings

4. Repair shorted insulating joints

5. Coat bare underground metallic structures
   A. Concentrated piping areas
   B. Buried valves

6. Recoat underground metallic structures
   A. Defective coating spots

7. Excavate pipe line for corrosion inspection and repair
   A. Indicated by holiday detector tests
   B. Indicated by surface potential tests
   C. Indicated by resistivity tests

8. Test facilities
   A. Repair broken test facilities
   B. Add new test facilities
      (1) New foreign line crossings
      (2) Vulnerable locations

9. Installation of supplementary cathodic protection facilities
   A. Work order procedure, etc. (standard)

VI. Check list for general office activities

1. Process field reports
   A. Semi-annual corrosion control survey
      (1) Check, calculate and plot data on corrosion control profiles
      (2) Reproduce profiles
      (3) Analyze profiles and data
      (4) Prepare corrosion report
         a. summary of findings
         b. conclusions
         c. recommendations
      (5) Distribute report and profiles to:
         a. field
         b. management
         c. other interested departments
      (6) Special studies
         a. current densities
         b. coating conductivity
         c. other
   B. Rectifier inspection report
      (1) Check
      (2) Analyze
      (3) Performance studies and statistics
   C. Installation report
      (1) Revise corrosion control profile forms to show change in facilities
      (2) Revise files
   D. Pipe line and coating inspection report
      (1) Check and study
      (2) Performance studies and statistics
   E. Foreign line interference report
      (1) Check and study
      (2) Follow up where necessary
   F. Surface potential report
      (1) Check
      (2) Analyze
      (3) Make recommendations

2. Administrative functions
   A. Budgets
      (1) Construction
      (2) Operations and maintenance
      (3) Capital additions

B. Reports: monthly, semi-annual, annual, special
C. Design new forms
D. Prepare manuals and guides
E. Set up codes and procedures
F. Approve field work order proposals
G. Approve purchases and service contracts
H. Conduct technical schools
I. Regular and special field inspections

3. Clerical work
A. Filing
B. Typing
C. Accounting
D. Drafting

VII. Experimental work and special studies

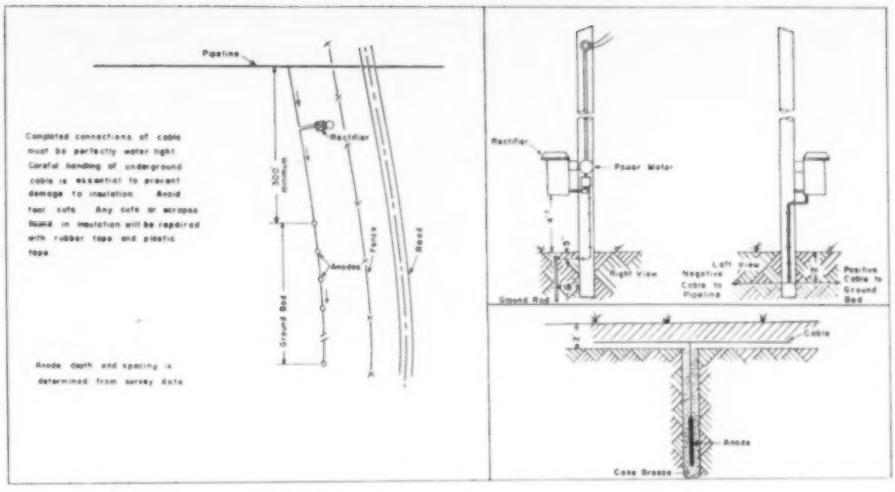
1. Laboratory
A. Coating
(1) Electrical conductivity
(2) Temperature effect
(3) Voltage effect
(4) Bonding qualities
(5) Penetration
(6) Flexibility
(7) Toughness
(8) Other

2. Field
A. Coating
(1) Resistivity
(2) Holiday
B. Pipe calibration (electrical current flow)
C. Ground beds (cathodic protection)
D. Other

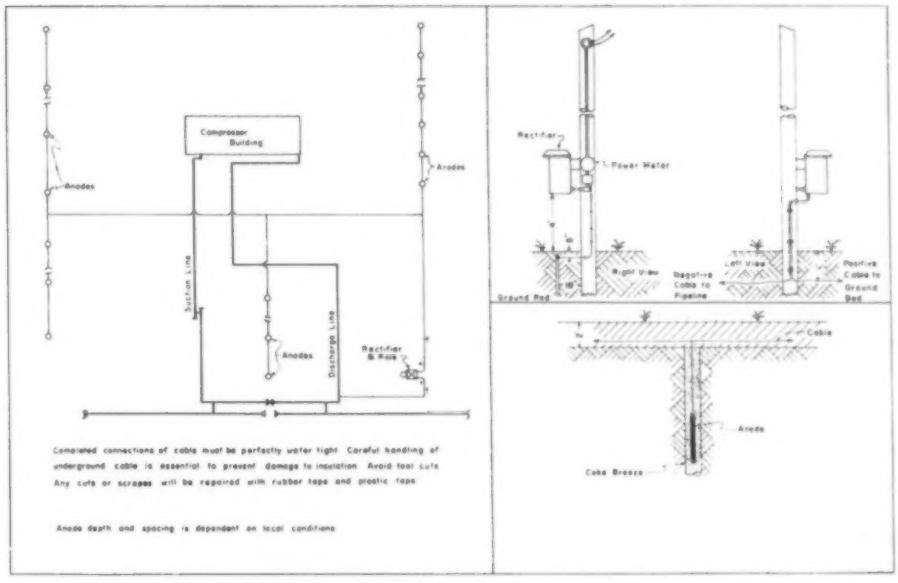
3. Office
A. Coating
(1) Make literature surveys
(2) Coordinate laboratory and field experiments
(3) Calculate and analyze
(4) Compile reports
(5) Make recommendations
B. Rectifiers
(1) Operation costs
(2) Anticipated life ground beds
(3) Life of stacks
C. Leak frequency
(1) Accumulative leaks curve
D. Cost analysis
(1) Construction
(2) Operation and maintenance
E. Protective status of pipe lines
(1) Percent coated pipe above—0.85 volts pipe-to-soil potential
(2) Percent bare pipe above—0.85 volts pipe-to-soil potential

VIII. Employe training

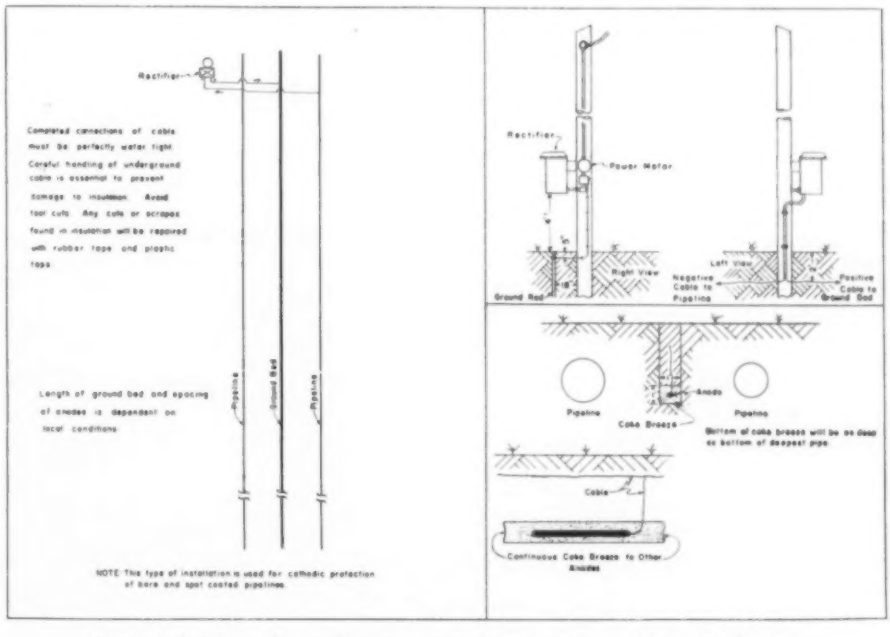
1. Indoctrination as helper or trainee
2. Manuals and necessary handbooks
3. Simplified math, physics, chemistry books
4. Daily half hour class (General Office only)
A. Applied math, physics, chemistry for natural gas operations
B. Specific operations instruction
5. Supervisors' weekly brainstorming session (General Office only)
6. Bi-monthly measurement school (full day session—field only)
7. Supervisors' annual seminar (one week sessions)



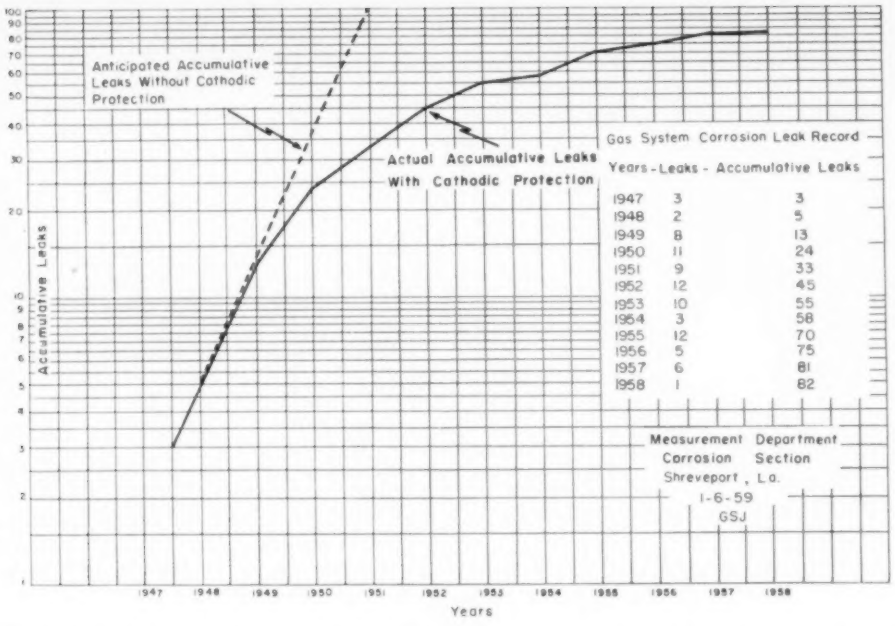
Typical remote ground bed—vertical anodes and rectifier installation.



Typical distributed anode ground bed and rectifier installation.



Typical horizontal continuous ground bed and rectifier installation.



Does cathodic protection do any good? Here is a plot of anticipated accumulative leaks without cathodic protection plotted against actual leaks with cathodic protection.

8. Local technical society meetings
9. Manufacturers factory training courses
10. Operating Dept. job education series
11. Interchange of employes between office and field
12. Technical library (Books available for loan)
    - (1) Text books
    - (2) Handbooks
    - (3) Short course publications
    - (4) Technical magazines
    - (5) Technical articles
    - (6) Operating and maintenance manuals
    - (7) Manufacturers bulletins

IX. Standard Report Forms (copies attached)
1. Corrosion Control Survey Data
2. Corrosion Field Test Data
3. Corrosion Field Data
4. Surface Potential and Soil Resistance Survey Data
5. Condition of Coating and Corrosion Pit Record
6. Corrosion Control Rectifier Inspection Report
7. Corrosion Control Installation Report
8. Corrosion Control Profile Sheet

X. Corrosion Control Installations
1. Test Sites
   - A. Standard test
   - B. Line Crossing
   - C. Calibrating
   - D. Calibrating alternate
   - E. Calibrated insulated joint
   - G. Insulated joint
   - H. Anode
2. Rectifier—Ground Bed (drawings attached)
   - A. Remote—vertical ground bed
   - B. Distributed ground bed
   - C. Parallel continuous horizontal

XI. Corrosion Leak Record
1. See graph of accumulative leaks

XII. Cost of Corrosion Program
1. See 1958 corrosion control cost summary

ADVANTAGES OF PROGRAM

As mentioned above, these functions are carried out by an instrumentation department which has collateral duties; and this arrangement has greatly enhanced the over-all efficiency of the operation. Rather than a thin line of corrosion engineers, this company has a sizeable, and well-spaced force with greatly reduced transportation problems.

About the Author

Pat H. Miller, superintendent of measurement and corrosion control of Texas Eastern Transmission Corporation, has been actively engaged in gas measurement and corrosion control in gas since 1926. He has been a leader and frequent speaker at corrosion meetings and gas measurement short courses. Miller, from 1927 to 1947, was associated with Panhandle Eastern Pipe Line Company and its predecessor companies. In May 1947, he was appointed to his present position with Texas Eastern. He has served as a member of such groups as the AGA Corrosion Committee, the committee to revise the Gas Engineers Handbook, the gas measurement committee, chairman of the task group to propose gas measurement research, a member of the supervising committee for large diameter orifice meter tube tests, and a member of the gas measurement panel. For the Southern Gas Association he has been a member of the Pulsation Research Council and he has been a member of the executive committee of the Southwestern Gas Measurement Short Course, as well as its general chairman. He is a member of the NACE, AGA, SGA, ASME, Mid-Continent Oil and Gas Association and Ark-La-Tex Measurement Society.

527 ME

CORROSION CONTROL SURVEY DATA

Pipeline: Line No 10 Kosciusko - Pend 30"H.L. Section No. 43 Between Stas. Baptist, Ala & Hi Pleasant M. P. 150.87 to 223.62
HCH Meter: Model B-2 No. 70 Scale 4/2 1/2 HCH Meter: Model A-2 No. 70 Scale 10 MV. Amp/MV Factor ____ Contact Lead. Res. 0.1000

TEST SITE NO.	MILE POST	DATE OF TEST	STRUCTURE/SOIL POTENTIAL PIPE volts	CASING volts	FOR.LINE volts	volts	CURRENT FLOW IR DROP mv	EXT. RES. ohms	CURRENT amps.	BOND DRAIN NO.	BOND RES. ohms	POT. DROP volts	DRAIN amps.	GALVANIC ANODE OUTPUT ma	RECTIFIER READINGS NO.	OUTPUT volts	amps.	
Sta Flange	150.87	4-9-58	-0.540															
Line Flange	150.87	4-9-58	-0.540															
Pig Trap	150.87	4-9-58	-0.785												53-1	8.0	5.2	9594
53-1	FARM ROAD Bld																	
53-2	151.01	4-9-58	-0.710				-.200	0.500	-0.89									
53-3	158.10	4-10-58	-0.653		-0.193						0.043	-.190	-4.41					
53-4	158.4	4-10-58	-0.733	-0.733														

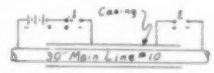
Portion of corrosion survey data sheet. There's a generous space at bottom for "Remarks".

CORROSION FIELD TEST DATA Sheet No. ____ Of ____

Date: 5/1/56 Time: ____ See Sheet ____ Dtd. ____ :Curve ____ Dtd. ____
Pipeline: 30" Main Line See Chart ____ Dtd. ____ :Chart ____ Dtd. ____

Between Comp. Stas. 57 & 58
Chain No. Danville To Owingsville
Approx.M.P. 427.2 To 502.0
MCM Meter No. 71 Scale ____
Ex. Res. ____ C.F. ____
Meter No. ____ Scale ____
Ex. Res. ____ C.F. ____
Amp./M.V.Factor: ____

Internal Resistance Between Casing and Pipe Survey 1956, Danville, Ky. Sta. 57 to Owingsville, Ky., Sta. 58



Internal Resistance Between Casing and Pipe Survey, 1956

Test Site No.	M. P.	E On mv	E Off mv	ΔE mv	ΔI Ma	R Ohms	Shorted or Insulated
1							
2	57-1	428.9	4	0	4	8100	0.0004	Shorted
3							
4	57-2	432.3	52.0	10	510	6400	0.079	Shorted
5							
6	57-3	434.3	4700	800	3900	1320	2.954	Insulated
0	57-19	467.7	3820	520	3300	2400	1.375	Insulated
1							

REMARKS: ____

Please send to Measurement Dept. Shreveport, Louisiana

SIGNED: M. R. Hickey
WITNESS: R. G. Thompson

Field test data is plotted on sheets such as this one.

Surface Potential and Soil Resistance Survey Data

PIPELINE COLLIGAN JCT → BOSSIER CITY BETWEEN COMP. STATIONS ____ & ____ STA NO. 525+00 TO 418+00

STA NO.	P/S POTENTIAL VOLTS	SIDE	SURFACE POT MV	SIDE	SOIL RES R	OHM CM	STA NO.	P/S POTENTIAL VOLTS	SIDE	SURFACE POT MV	SIDE	SOIL RES R	OHM CM
525+00	-0.955		-6.4				371+00	-1.010		-18.5			
526+00	-0.927		+27.6				372+00	-1.009		+0.6			
527+00	-0.941		-16.4				373+00	-0.992		+13.1			
528+00	-0.926		+21.1				374+00	-0.975		+7.9			
529+00	-0.912		+7.8	+22.3			375+00	-0.981		+4.0			
530+00	-0.990		-7.8.0				376+00	-0.966	Ground	+4.5			
531+00	-0.951		+39.0				377+00	-1.040	Direct	+10.0			
361+00	-0.998		-35.2				414+00	-1.056		0.0			
369+00	-1.000		-5.7	+18.4			415+00	-1.052		+2.65			
530+00	-0.992		+8.3										

PLEASE SEND TO MEASUREMENT DEPT. SHREVEPORT LOUISIANA

DATA TAKEN BY CWD CK BY BMD
CREW JC, TNH, BMD
DATE 8-23-56 PAGE 11

Potential and resistance survey.

Condition of Coating and Corrosion Pit Record

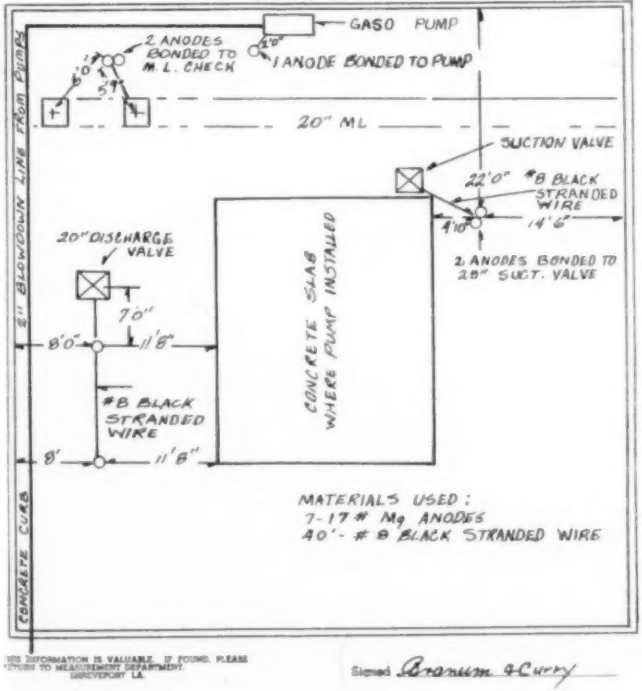
Division No. 4 Between Sta. JOAQUIN & Sta. LONGVIEW Date 9-30-57
M.P. ____ Rechain No. ____ To Rechain No. ____
Pipe: Size O.D. 20 Wall Thickness .281" Ft. Exposed 2
Reason for Exposure FOREIGN LINE CROSSING
Is Pipe Fitted No Deepest Pit ____
Location & Description of Pits ____
Gas Leaks: No
Type Coating: CLASS D
General Condition of Coating GOOD
Nature of Soil CLAY & ROCK Type HILLY
Remarks ____
Signed C. J. Smith
Report Noted by ____ Filed by ____

Any pits that are discovered should be recorded.

Corrosion Control Field Data

DATE 5-6-58 Sheet No. ____ of ____
PIPELINE 20" PROD. STA. 9
LOCATION OR SECTION ____

ANODE INSTALLATION IN STA. 9 PROD. STA. YARD.
7 Mg ANODES INSTALLED TEMPORARILY



MATERIALS USED:
7-17# Mg ANODES
40'- # 8 BLACK STRANDED WIRE

THIS INFORMATION IS VALUABLE. IF FOUND, PLEASE RETURN TO MEASUREMENT DEPARTMENT, SHREVEPORT, LA.

Signed Branum & Curry

Drawings—even rough ones—are essential.

MEASUREMENT DEPARTMENT
Corrosion Control Rectifier Inspection Report

Rectifier No. OS-24 Location Kratz Spring - La.
Between Comp. Stas. Opelousas & St. Francisville M.P. 149.9
Lines #14 Division IV
Date Last Insp. 4-9 Volts 8.9 Amps. 7.2 Ohms Res. 1.23 PMR 1530
This Date 5-9-58 Volts 9.0 Amps. 7.4 Ohms Res. 1.22 PMR 1605
#14 P/S 1.068 P/S ____ P/S ____ P/S ____
Rectifier Max. Rating 12V 10A Previous Efficiency 60 %

Efficiency = 9.0 D. C. Volts × 7.4 D. C. Amps. × 66 Seconds × 100 / 1 × 3600 × 2 Revolutions = 61 %

Adjustments or Repairs Made. NONE

How to maintain regular inspections of rectifiers.

Corrosion Control Installation Report
MEASUREMENT DEPARTMENT

Division II Location M.L., Sta. 18 t. 19 Date 4-19-56
Section 32 Line 20"
Rechain Sta. 54495+20 M.P. 1032.1 W.O. ~~XXXX~~ 4216

- ☐ Test Site: No. ____ Type ____ Foreign Line ____
- ☐ Rectifier: No. ____ Mfgr. ____ Rating ____
- ☐ Anode: Kind ____ No. ____ Size ____ Output ____
- ☐ Bond: ~~Resistance~~ Resistance Ohms Res. 0.05 Amps. Drain +0.8
- ☐ Casing: Int. Res. ____ Filled ____
- ☐ Insulating Flange: Type ____ Size ____ Int. Res. ____
- ☐ M. & R. Station ____ ☐ Main Line Valve ☐ Tap

Remarks 4" National Gas & Oil Crossing
P/S Potential= -1.46 volts

Installation report on corrosion control measures.

—The End

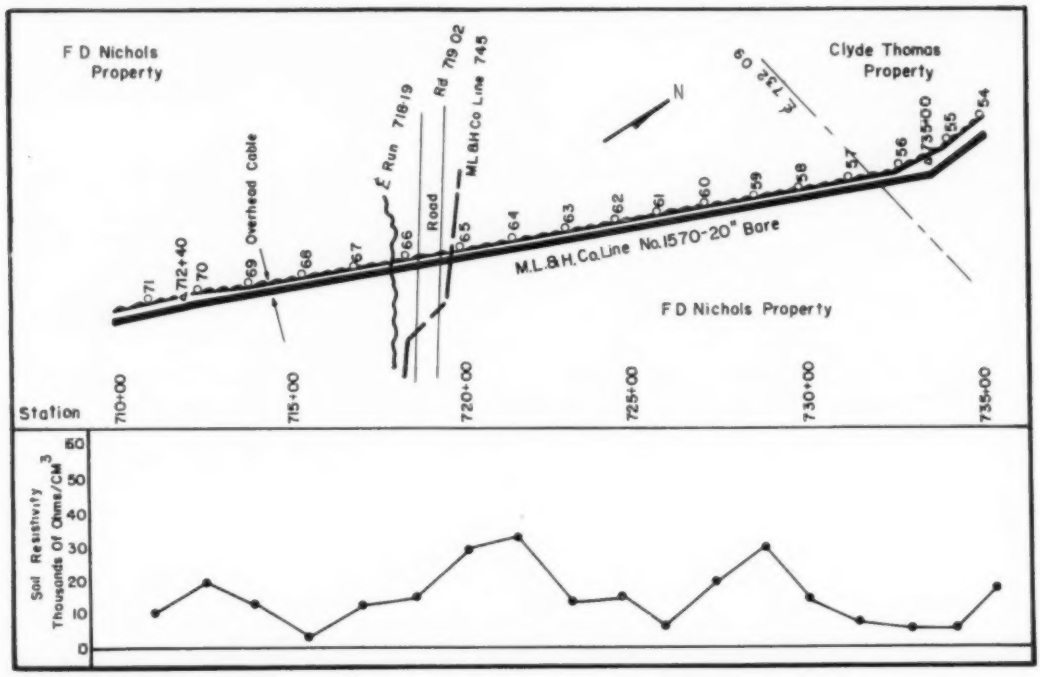


FIGURE 1—Distributive ground bed installation and soil resistivity survey. The pole line paralleling the pipe line in the right-of-way made it possible to set up this study under almost ideal conditions.

How Weather Affects Cathodic Protection of Pipe Lines

Temperature effects are slight, but heavy rains cause current requirements to soar

By F. E. Costanzo, Senior Engineer
The Manufacturers Light and Heat Company
Pittsburgh, Pa.

To DETERMINE the effect of weather on cathodic protection performance of pipe lines, The Manufacturers Light and Heat Company started an investigation in 1951 and continued it through 1957.

Here are the significant conclusions drawn from the data regarding weather and cathodic protection:

1. Temperature has little or no effect on cathodic protection current required
2. Precipitation of over ½ inch makes a definite change in the cathodic protection current requirement
3. Precipitation in excess of 1½ or 2 inches has little additional effect because of "run-off" from the surface
4. Effects of precipitation are transient. When rainfall stops cathodic protection current begins to return to normal although this may be affected by the degree of rainfall
5. Snow has much less effect upon cathodic protection than the the water equivalent of that precipitation.

A 19,500-foot stretch of bare 20-inch pipe laid in 1948 in a 54-inch deep trench with at least 30 inches of cover above the top of the pipe was selected for the investigation. This stretch of pipe line was paralleled by a telephone pole line along the right-of-way approximately 10 to 20 feet from the pipe line. It passed through the company's Waynesburg, Pa., compressor station. Where company personnel operated the U. S. Weather

Bureau station for Greene County, Pa. this tied in handily with the experiment.

A 20-volt 40-ampere rectifier was used to supply cathodic current. This rectifier was conveniently located 100 feet from the weather station at the Waynesburg compressor station with the pole line extending away from the station. This pole line made it possible to use a distributed ground bed with anodes installed at the base of each pole, the pole spacing varying from 150 to 250 feet, depending upon the terrain. A No. 3/0 bare aluminum cable was used as a gathering wire, with No. 10 copper wire for the drop leads to the anodes.

One-hundred and ten magnesium anodes were used on the original installation, with one magnesium anode at the base of each pole. Magnesium anodes were used as the original ground bed to determine their efficiency. Several of the magnesium anodes were completely consumed after 30 months of operation, and most of the remainder were replaced after 4 years of operation. The replacement anodes are aluminum, graphite or high silicon iron.

Figure No. 1 is a strip map of a typical section of the line showing the ground bed installation and the soil resistivity profile. Normal variation in resistivity ran from a low of 3,850 ohms per cubic centimeter to a high of 34,000 ohms. However, resistivity of 125,000 ohms per cubic centimeter was indicated at Station 25. The single anode output varied from 28 milliamperes in 125,000 ohm soil to 380 milliamperes in 3,850 ohm soil.

Prior to the beginning of the experiment (August 1950), the initial output of the rectifier to provide adequate cathodic protection was 24 amperes at 18 volts for the 19,500 feet of 20-inch pipe.

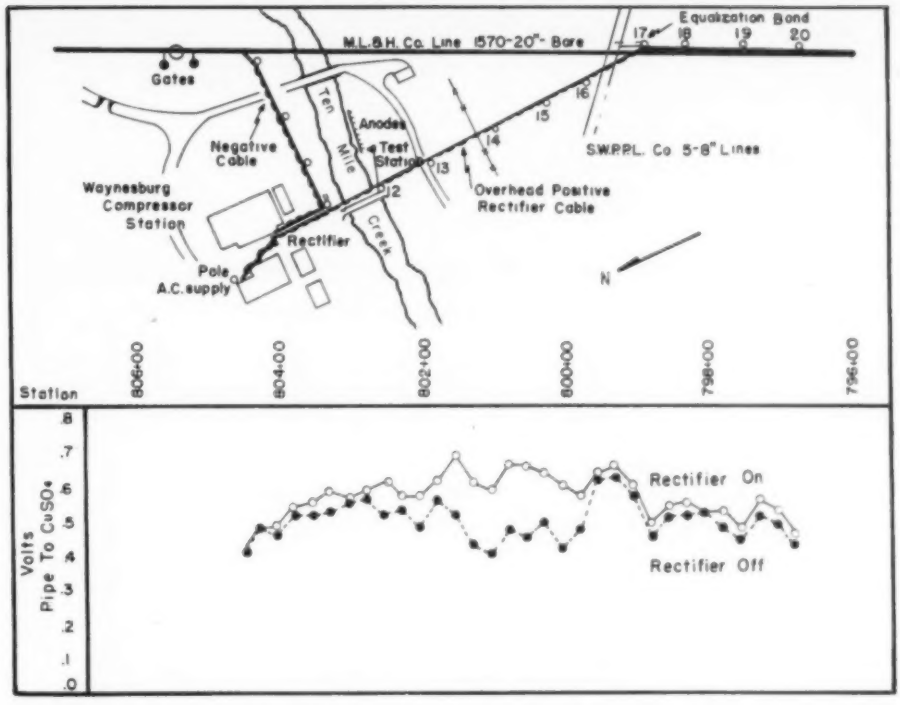


FIGURE 2—Waynesburg compressor station cathodic protection layout and pipe to copper sulfate survey.

Test procedures. The basic procedure for determining minimum current requirement is the method which indicates a change in the "on and off" pipe to $CuSO_4$ potential. The McCollum earth current meter was used to spot check areas where very slight changes between "on and off" were noted, and adjustments were made to increase the output of the rectifier where the earth current readings were positive. No changes in rectifier setting have been made since the initial installation. In the valuation, the importance of knowing the minimum cathodic protection current required is obvious.

Four major pipe lines cross this section of the test line, and equalization bonds were established with the agreement of the companies concerned. The current requirement for these bonds is a total of 1.632 amperes.

Since August 1950, there have been daily readings taken at 7:30 a.m. showing the weather information, including temperature and rainfall, and at the same time the reading on the ammeter at the rectifier. Corrosion surveys of the pipe line have been made annually, and Figure 2 shows a typical section of pipe line with the corresponding $CuSO_4$ potential taken every 25 feet along the line. The data used in this report runs from January 1951, through December 1957.

Atmospheric Temperature Studies. In order to show any possible correlation between atmospheric temperature, rainfall, and current requirements as shown by the ammeter reading on the rectifier, three items were plotted on successive curves by calendar years. Figure 3 shows the data for the calendar year 1951. The daily temperatures were taken at 7:30 a.m. each day. These temperatures were averaged on a 7-day basis for successive 7-day periods throughout the calendar year. The average curve follows generally the plot of the individual temperatures taken at 7:30 a.m. each day, but there is some tendency to level out these early morning temperature effects. The middle

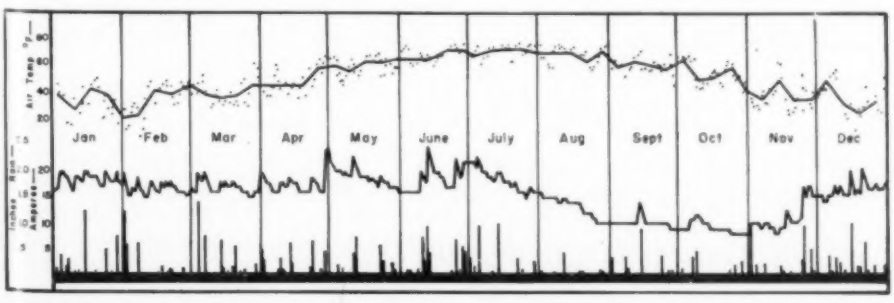


FIGURE 3—1951 daily readings of atmospheric temperature, rainfall and cathodic protection.

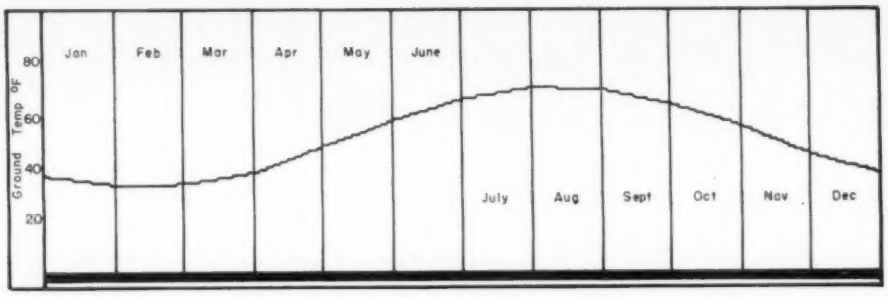


FIGURE 4—Daily ground temperatures.

FIGURE 5—1952 daily readings of atmospheric temperature, rainfall and cathodic protection.

curve on the chart is a plot of the output of the rectifier in amperes as read at 7:30 each morning. The bottom curve is actually a bar graph showing, to scale, the number of inches of rainfall in the preceding 24 hours. These readings were also taken at 7:30 each morning.

As is to be expected, the atmospheric temperature shows itself to be an annual one-cycle curve with waves representing colder or warmer periods. Successive curves for following years show the same characteristic cycle. The plot of current output from the rectifier seems to have no regular cycle, except for the fact that in this particular year there was a low output during the months of September, October, and the first half or two-thirds of November. There is no sign of any correlation between atmospheric temperature and cathodic protection current. Curves for other years show this same general lack of correlation.

Effects of Ground Temperatures. When it was established that current requirements did not vary with atmospheric temperature, the next logical step was to see if it varied with the ground temperature. To determine the answer to this question, Manufacturers' corrosion engineers plotted on Figure 4 the data collected by the U.S. Bureau of Mines showing ground temperatures at various depths for various geographical areas. The data plotted in Figure 4 are for a depth of 30 inches in the Pennsylvania Appalachian area. Here, again, we have a simple one-cycle curve which actually follows rather well the average atmospheric curve comparing this curve with that for current requirements for the year 1951 again discloses no more relationship between current requirement and ground temperature than there was between current requirement and atmospheric temperature.

Rainfall vs. current requirements. Comparison of the current output and the rainfall curve is a totally different matter. It is quite obvious that rainfall does affect the current curves. This correlation on the two curves is readily apparent. Note that in mid-September after several "dry" days, 0.8 inch of rain fell and the current for that day had a sharp increase.

The data of this curve alone shows there is a variation in current requirement with rainfall. Moreover, this curve indicates that the magnitude of rainfall in a day is an important factor. However, there appears to be some breaking point at which rainfall has an effect on current consumption. Consider, for example, the first few days and the last few days of September. On both of those occasions about 0.4 inch of rain fell with no increase in cathodic current. Again looking at the middle of September, there was one day with more than a half inch of rainfall and a corresponding sharp increase in current requirement. From the data on this curve we would be tempted to say that the current requirement would increase when the rainfall is more than 0.5 inch in a day.

Snowfall Effects. It should be borne in mind that as plotted on this bar graph all rainfall is shown in equivalent inches—that is to say, if there was snowfall, that snow would be reported in inches of water. It becomes important to remember this when we look at January 15, 1951. On this day there was approximately 20 inches of snowfall equivalent to 1.28 inches of water when melted. But because the snow did not immediately melt, there was no sharp increase in current requirement. It would appear that snowfall does not cause an immediate change in current requirement, but rather furnishes the water over a greater period of time to maintain higher current requirement than when there is no snowfall or rainfall.

For 1951, the period of maximum current requirement occurred in June, at the end of April and the first of May. The minimum corrosion period came in September, October and the first part of November with the tendency to corrode (as indicated by current requirements) increasing during the latter part of November and maintaining a relatively uniform level until the latter part of April.

Before we are accused of drawing too many conclusions from a single year's operation, let us look at Figure 5, which is a plot of the data for 1952. Once again, the temperature data, either daily or by 7-day mean, follow the single-cycle atmospheric curve. And once again, as we look at the bar graph and the current requirements, we see that when there is a lot of rainfall the current requirement goes up; when there is no rainfall, the current requirement goes down, regardless of what the atmospheric or ground temperature may have been. Again, the periods of maximum corrosion as indicated by current requirements are in the months of May and June, and the months of October and November indicate the minimum corrosion period.

This same general pattern, with an occasional displacement to earlier or

later months, was found to be true for the rest of the annual curves and data. Note particularly the heavy rainfall on Figure 5 increasing toward the end of the month during the month of May 1952, and the fact that current requirement built up steadily as the rainfall continued. Note also that rainfall gradually fell off during the month of September, with little rainfall in October except during the first part of the month. This drought lasted until late November, and that during that period the tendency to corrode (as indicated by the current requirements) fell steadily, then held at a constant.

Now to look at the effect of the magnitude of the daily rainfall. Consider, for example, January when there was one day with more than an inch and a half of rainfall followed by a number of days with little or no precipitation. Immediately, the current requirement jumped from slightly over 15 to approximately 20 amps, and immediately fell back to 15 when the rainfall did not continue. There were small amounts of rainfall in the first week of February, and then a day with approximately one-half inch, and immediately the current requirement increased.

From the 1951 data, we had made a preliminary conclusion that 0.5 of an inch was a sufficient rainfall to produce a significant change in current requirements. The 1952 data seemingly corroborates this conclusion. Month after month, as we look across the rainfall curve and compare it with the shape of the curve above it, we note that 0.5 of an inch or more of rainfall *does* produce peaks. The prime exception during this particular year seems to come in the latter part of July when 0.5 of an inch of rainfall had very little effect on current requirements. One explanation is that for the previous weeks there had been less than normal amount of rainfall, with the consequence that the ground had become particularly dry and resistance particularly high.

The data for 1953 are plotted on Figure 6. This year was dry. However, even that year with the least precipitation of the seven included in this report, the period of least current requirement came in October and November. Because rainfall was uniformly off for the entire year, there is no continued plateau of high current requirements, but once again the absolute high for the year occurs in May, coinciding with a 2¼-inch rain which

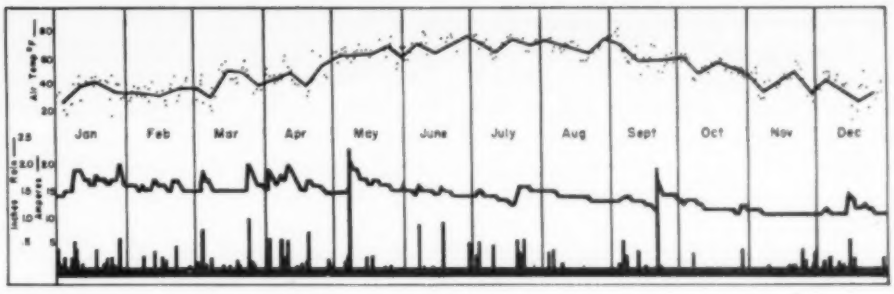


FIGURE 6—1953 daily readings of atmospheric temperature, rainfall and cathodic protection.

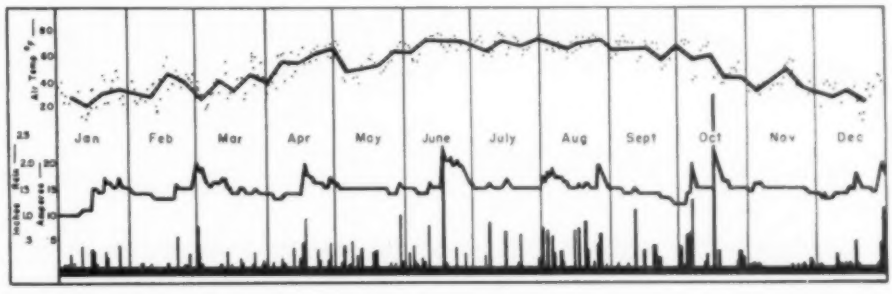


FIGURE 7—1954 daily readings of atmospheric temperature, rainfall and cathodic protection.

came in one day. Considering just the data of this curve, there is still a single cycle of corrosion tendency at a higher level during the winter, spring, and early summer months and at a lower level during the late summer and early fall months.

The almost continuous level of current requirements from the latter part of January until the latter part of September—in fact, for the entire year—would in itself be condemnation of any conclusion that either atmospheric temperature or ground temperature had anything whatever to do, from a fundamental nature, with current requirements. The waves superimposed on the annual curve of current requirements coincide with precipitation. Once again, the magnitude of the precipitation must be considered. This is true even when there has been a long, dry period before the precipitation. Consider, for example, the first rainfall in September that exceeded 0.5 of an inch. Immediately the current requirement curve has an increase, followed, because there was no further rainfall, by an immediate decrease; and then, when in the latter part of September, there was a rainfall again of approximately 2 inches, there was an immediate increase in current requirement. For this particular installation, at least, it becomes more and more apparent that 0.5 of an inch of rainfall is the critical amount of rainfall to produce an increase in current requirements.

Let us look next at the data for the year 1954, as plotted on Figure 7. The highest rainfall for the year occurred near the middle of October. There was a corresponding increase in current requirements for that day and the day following. The amount of rainfall on this particular day was more than normal for any one day for the year and leads us to speculate whether or not an excessive amount of rainfall has an excessive effect on current requirements. It would seem, from the comparison of current requirements on this day with a day about the middle of June when the amount of rainfall was slightly over 2 inches, with almost equal current requirements on both occasions, that rainfall in excess of 2 inches does not have a proportionate effect on current requirements. There is data on a succeeding year to help substantiate this conclusion, though two occasions do not constitute sufficient data to set the top limit for the effect of rainfall. It may be possible to set a current increase as the maximum that is likely to occur, regardless of the magnitude of the rainfall, if the rainfall exceeds 1.5 inches.

Figure 8 is a plot of the data for the calendar year 1955. Data for the months of January and February and the first two-thirds of March represent the kind of isolated data some-

times quoted to indicate a relationship between atmospheric temperature and the current requirements for cathodic protection. Note, for example, the correlation between atmospheric temperature and current requirements between January and March. But beyond March the correlation fails. The temperature continues to rise through the month of April as the current requirement drops to the low point, or the same point, that it was during the first half of January.

The latter half of May illustrates another point that has been noted from comparison of rainfall and current requirements. A recurrence of rainfall of more than 0.5 inches but not more than 1½ inches produces a greater proportionate change in current requirement when the recurrence is within a very few days. In June on this curve, a rainfall of approximately 1½ inches produced the peak corrosion conditions, and successive days of rainfall of 0.5 inches or slightly less produced a sustaining effect on that corrosion conditions; but with the absence of rainfall after the middle of June, the curve immediately declines to about the level of the preceding months of February, March and April. In fact, successive rainfalls of more than 0.5 inches separated by one or two days each time, produced only localized waves on the general current requirement curve; but in the latter part of August, successive days of rain of more than 1 inch produced pronounced change in the current requirement curve, and one additional day of rainfall of more than ½ inch was sufficient to sustain that curve over the latter part of August and the first half of September.

A plot of the data for the calendar year 1956 is shown in Figure 9. During the year there was a total of 57.22 inches of precipitation, more than twice as much as during the dry year of 1953. On July 27 there was 5.21 inches of rainfall in a 24-hour period; by far the most precipitation on any single day for the period of the study to date.

For this year, the period of maximum current requirements came in late June, July and early August. The minimum requirement again was October and November. Precipitation in January occurred as snowfall, except for rain the last three days of the month. Note that the current requirement remained at an almost constant level, except for the last three days when it increased to 15 amperes.

Sub-Freezing Temperature Effects. From a comparison of current requirements, rainfall and ambient temperature on this curve and those presented previously, it is obvious that current requirements are slow to build up when the ambient temperature is below 32°, indicating that any precipitation was snowfall. This is undoubtedly due to two factors, at least: (1) the slow dissipation of water which occurs by reason of the melting of the snow over a period of time and (2) much of the precipitation falling in the form of snow never moistens the ground, but instead is evaporated into the atmosphere.

Runoff effects. Let's look at the data with respect to July 27, when there was more than 5.2 inches of rainfall. The current requirement barely exceeded that for the day in the first week in August, when rainfall was approximately 1.7 inch, again illustrating the fact that beyond 1½ inch of rainfall the major portion of the water runs off the surface of the ground, and has little or no effect upon the conductivity of the soil at the depth of the pipe line.

The total annual rainfall for 1957 was 32.45 inches as plotted on Figure 10. The ampere curve for 1957 compares to 1953, Figure 6, when we had 28.16 inches of rainfall. With rainfall uniformly off, the entire year results in a continuous plateau with no high corrosion tendency. The 10 ampere average output of the rectifier indicates the uniformity of the small amount of rainfall during the year. There were 15 days having over 0.5 inches of rainfall and this compares with the 30 days rainfall for the average year and contributes to supporting

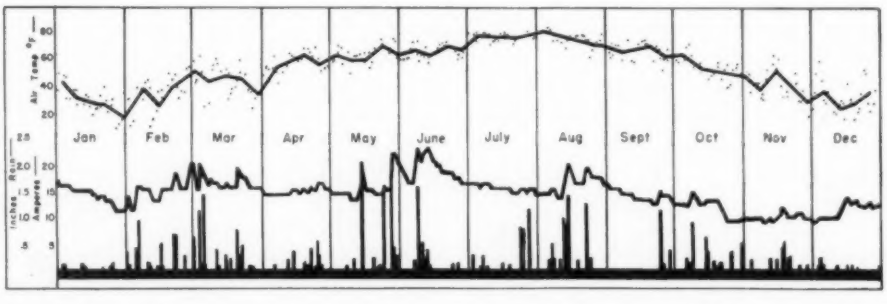


FIGURE 8—1955 daily readings of atmospheric temperature, rainfall and cathodic protection.

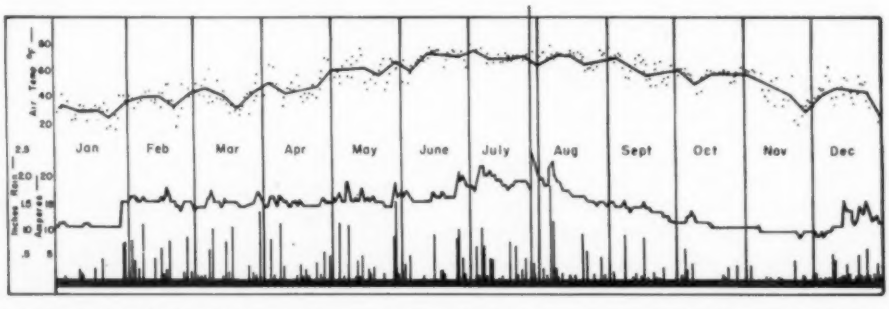


FIGURE 9—1956 daily readings of atmospheric temperature, rainfall and cathodic protection.

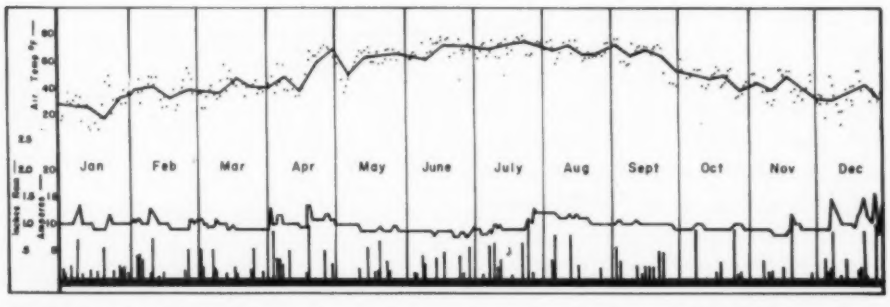


FIGURE 10—1957 daily readings of atmospheric temperature, rainfall and cathodic protection.

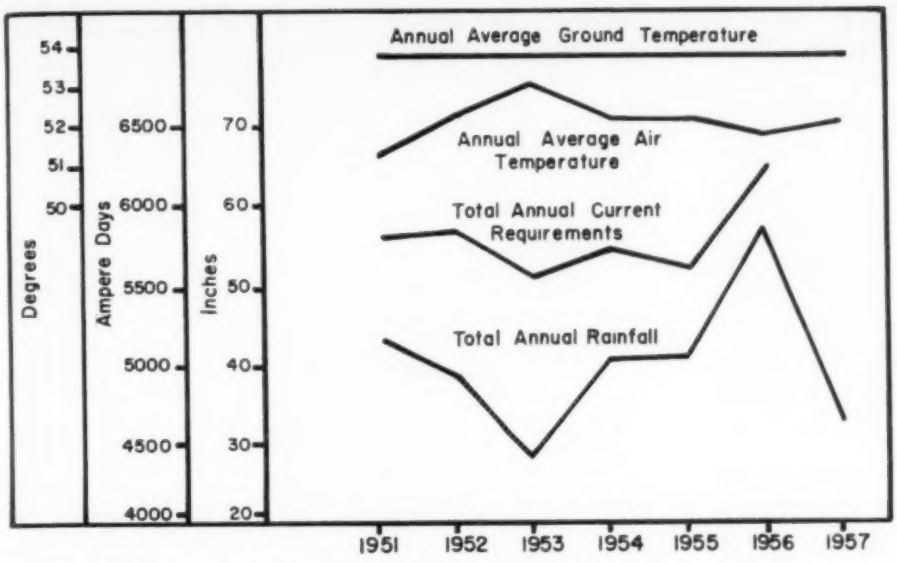


FIGURE 11—Annual averages of weather and cathodic protection current.

the flat current curve. The change in current when over 0.5 inches of rain occurs can be noticed for the day of the rainfall and the day after. This is another indication, if an excess amount of rainfall does not exist, there will not be an excess amount of current required.

Each year has its peculiarities; 1957 is no different. The maximum rain for one day was 1.2 inches, compared to 5.21 inches in 1956. Another difference was 90 days of rainfall during the year compared to 173 days of rain in 1956. The average air temperature for the seven years presented is 52° F, and 1957 comes close to the average with 51.99° F. No temperature effect on cathodic protection requirements was observed.

The dissipation of the ground bed over the years should be considered during the year. We found approximately thirty ground bed anodes dissipated and the ground bed anodes on each side of the completely used anodes had increased their output during the year. The actual total annual current requirement was below that of the minimum cathodic protection requirement, and for this reason it has not been shown on Figure 11. We feel the loss of the ground bed anodes with the subsequent loss in potential made the 1957 current requirement of no material value and is only presented here to explain the daily comparison with the weather.

Effect of bacteria? An attempt was made to determine the reason for the ordinarily greater corrosion tendency occurring in the months of May, June or July, and the lesser corrosion tendency occurring ordinarily in the months of October and November. There is an additional postulate regarding this swing between spring, summer, and fall other than that possible by temperature of atmosphere alone. It is that the increase in corrosion tendency during the summer months and the decrease in the fall or winter months may be produced, in part, by bacterial corrosion.

Previous investigators of bacterial corrosion have reported seasonal variations in the bacteria populations and that the anaerobic bacteria, including the sulfate reducing bacterial, accelerate the tendency to corrode. Some bacteria can live only when supplied with dissolved oxygen, others grow only in the absence of oxygen. The heterotrophic bacteria require organic matter as a source of energy. The autotrophic utilize inorganic substances as energy sources. All of them are affected by ground temperature in that they grow more rapidly under warm ground conditions or fail to grow at all under cold conditions, and that they require adequate moisture for their propagation.

Regardless of the ground temperature, the bacteria do not grow in the absence of adequate moisture. For this reason even the effects of bacterial corrosion are materially influenced by rain or snow. In order to determine the overriding influence of bacterial corrosion, an additional investigation has been instigated utilizing the company's recent developments of the Redox Probe.

Seven-Year Summary. Figure 11 is a summary curve of the data for the years 1951 through 1957, showing the annual average ground temperature, the annual average air temperature, the total annual current requirement, and the total annual rainfall. The configuration of the total annual current requirements with the total annual rainfall, and the complete lack of configuration with either the annual average air temperature or the annual average ground temperature is obvious.

The year 1953 with the least amount of precipitation, a total of 28.16 inches for the year, required the least cathodic current, a total of 5,143 ampere days. The year 1956 with the most precipitation, a total of 57.21 inches, required the most cathodic current, a total of 6,451 ampere days. In substantiation of the contention that above 1½ inches of rainfall at a time there is little or no increase in the cathodic current required, consider that 1956 had twice the precipitation of 1953 but required only 25.4 percent more cathodic current than the year 1953.

Corrosion engineers desiring to determine the adequacy of cathodic protection for an underground structure should conduct these tests following one-half inch or more of rainfall, and that preferably during the months from May through August.

ACKNOWLEDGMENT

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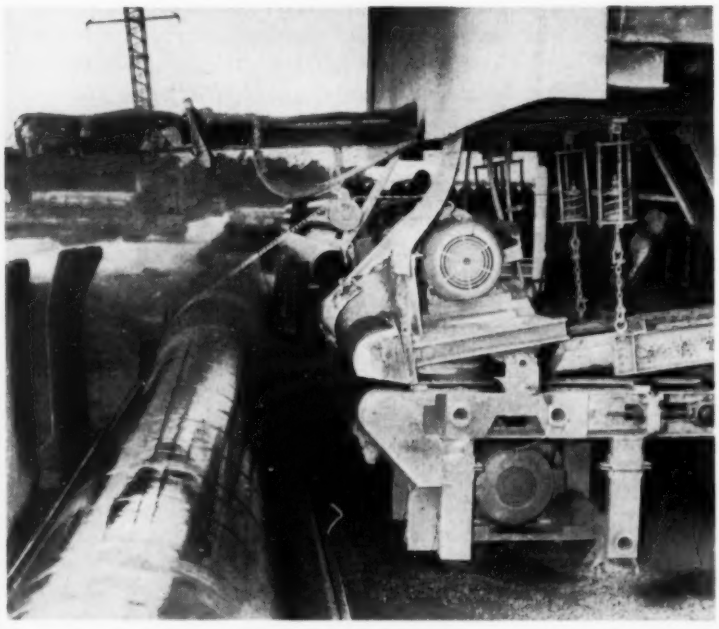
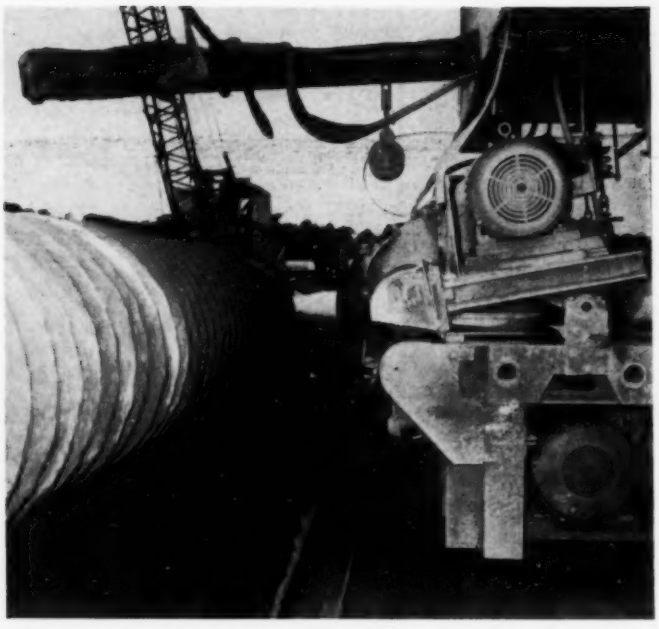
About the Author

Frank E. Costanzo is senior corrosion engineer with The Manufacturers Light and Heat Company. He received his B.S. degree in mechanical engineering from the University of Pittsburgh in 1933. He has been working in corrosion since 1945 and is a member of the National Association of Corrosion Engineers' Board of Directors, representing the Northeast Region. Costanzo is a Lieutenant Colonel in the U.S. Army Reserve and the commanding officer of a Research and Development Unit.



Start of concrete application. Electric driven endless belt and wire brush rotating at 2300 rpm sprays concrete on pipe. Applicator in foreground applies first coat, then a wire mesh coating is spun on pipe before second coat is applied, in background. Each joint is water sprayed before concrete is applied.



Joint reaches finish with 2½ inches of concrete added to 20-inch pipe. Production time for each joint: approximately 6 minutes. The system coats about 75 joints daily.

New Design Featured In Concrete Coating Plant

In Gulf Coast area humid air can dampen any cement; new design of unloading and storing system eliminated this problem at Harvey, La. yard

By Donald G. DePugh
Construction Editor
PIPE LINE INDUSTRY

IMPROVEMENTS CONTINUE to take place almost every day in pipe line coating methods and techniques in an effort to gain improved quality and higher production. Here is a good example of one of the most recent.

At Harvey, La., Pipe Line Service Corporation overcame a major "area" problem created by effect of the humid Gulf Coast atmosphere when concrete coating pipe joints.

Problem: Handling and storing dry cement and keeping it free from moisture contamination.

Solution: Install a dehumidified air pressure system to eliminate moisture in transferring cement from railcars to storage tanks and concrete mixers.

From unloading railcars, cement is guided down an "air-slide" or pipe chute, having a 1-inch carborundum stone false bottom, which provides a smooth gravity flow of cement into an underground pressure vessel. An air stream passes up through the porous carborundum stone and "floats" cement down the chute. From the underground vessel, cement is transported by a 40 psi dehumidified air stream to the 350,000-pound capacity storage tank. Cement can be piped from the vessel directly to concrete pug mixers if necessary.

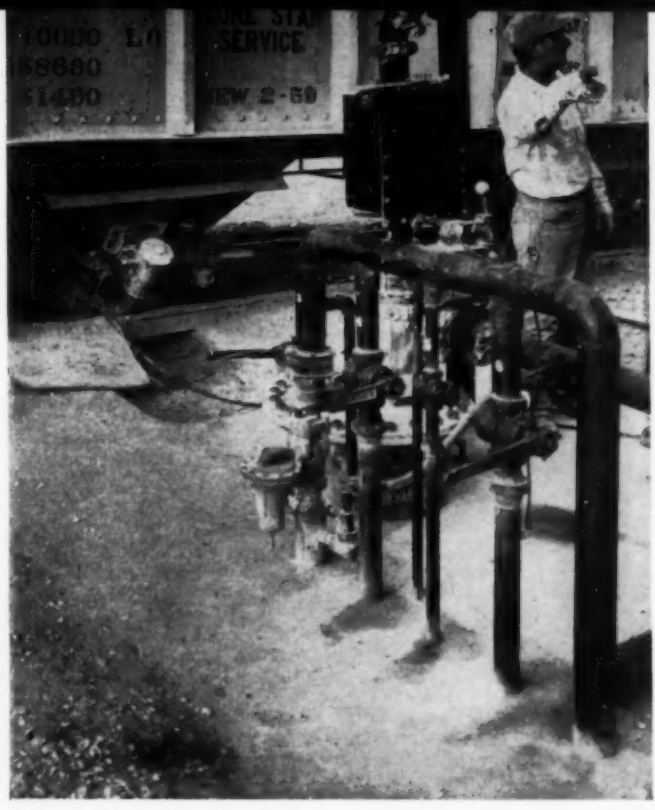
An air dryer on the 315 cfm air compressor dehumidifies all air used in unloading and storing cement.

$2 Million Plant. The new unloading and storing facilities are part of a $2 million yard coating and concrete coating operation which handles pipe from 12 to 30 inches in diameter. At this 24-acre site on the Intracoastal Canal are three conventional coating and wrapping plants and a smaller concrete system for pipe up to 12 inches.

Cement, sand and other components are automatically conveyed to concrete pug mixers. Cement is moved by 40 psi air stream from storage tanks; sand and aggregate are carried from railcars on conveyor belts.

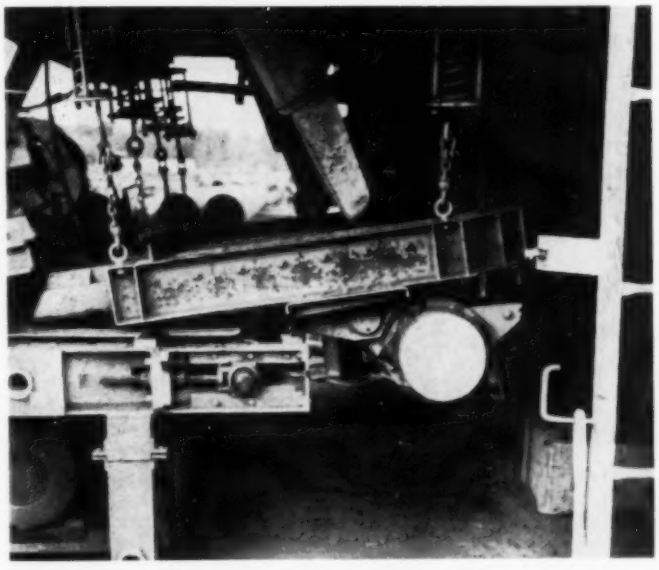
Material handling is virtually automatic to the pug mixers located above two concrete applicators. Each mixer consists of two sections, back section for dry mix and a front section for wet concrete mix. Sand, aggregate and cement are blended according to specifications in dry mix; combined material travels to front section where water is continually sprayed into mixer. As mixing is completed, coating passes directly to applicators below.

Coating Machines. Concrete applicators are made up of an electric driven conveyor belt and rotating wire brush. Concrete drops from mixer into a steel tray which is vibrated at an

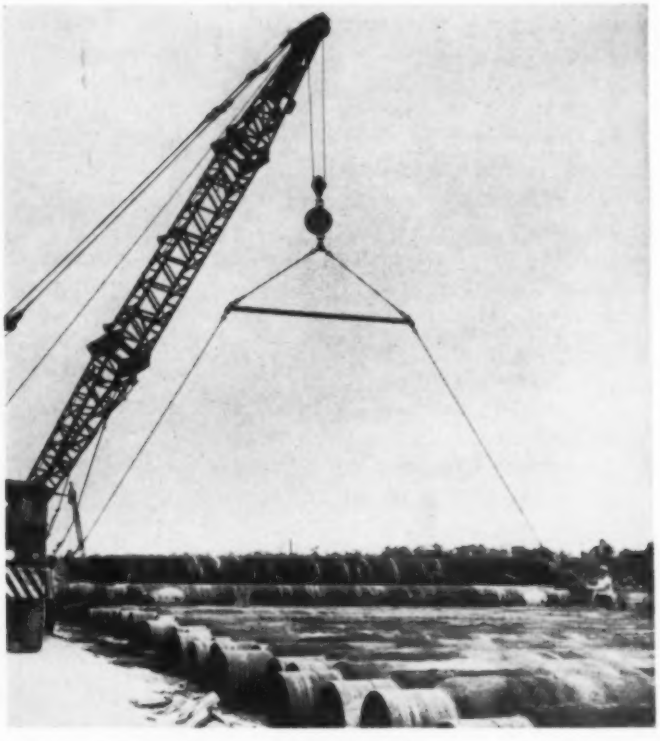


Cement is unloaded under two pounds air pressure. Electric motor vibrates cement funnel to provide even, smooth flow from railcar into pipe. Cement moves to storage vessel underground; from there it goes to storage tank or directly to concrete mixers.

At Pipe Line Service's Harvey, La. plant this cement unloading and storage system receives bulk cement from railcars, left, and moves it under a dehumidified air stream to storage. Cement is then piped to pug mixers for concrete coating process. Lights on top of tank indicate whether tank is full, half-full or near empty. Air compressor and air dryer are located below tank.



Concrete is fed from mixers into vibrating tray which distributes concrete at an even rate onto conveyor belt. Coating is applied to pipe from conveyor by rotating brush. An electric motor at lower right vibrates suspended tray.



Cranes which pick up coated pipe and move it to storage or barge, truck and railcar, are equipped with scale to check weight of pipe. Receiving 2½ inches, 165-pound density concrete, these 20-inch, 40-foot joints weighed about 11,500 pounds.

even speed by an electric motor drive moving concrete to the conveyor belt at a constant rate. This assures fine control of concrete as it is sprayed onto pipe brushes rotating at 2,300 rpm.

Each machine applies one coat to pipe; a wire mesh is wrapped between coats to insure accurate placement. After final concrete coat, each joint receives a curing spray.

Two-Way Operation Speeds Production. Pipe may be lined up on both sides of concrete coating station; electric dollies can pull joints past applicators from either direction to expedite operations.

Production on 20-inch pipe applying 2½ inches of concrete is about 75 joints per day. Finished joints are moved by cranes to sand storage beds for curing prior to shipment by barge, railcar or trucks. Cranes are equipped with scales to check weight of each joint. Physical checks on density of concrete are taken periodically.

To obtain a density of 140 pounds, the Harvey plant uses sand and cement for concrete coating. For 165-pound density, sand, cement and iron ore aggregate are used. For 190-pound density, a barite aggregate is added to cement. —**The End**

Fundamentals . . .

Keep the Over-all Corrosion Picture in Mind

. . . when dealing with impressed current installations

By Wm. A. Hutchison
Senior Electrical Engineer
Sinclair Pipe Line Company
Independence, Kansas

THE MAJOR objective of the corrosion engineer is to protect underground structures. Why? To save money! Investment money and operating money. Every decision he makes and every purchase as well must be directed toward this objective. But he must always keep the over-all picture in mind. Let's briefly review our corrosion mitigation tasks.

The major cause of corrosion in pipe lines stems directly from chemical processes. One involves a flow of electrical current which causes a chemical reaction to take place. The other involves a chemical reaction which causes an electrical current to flow. In either case, there is a flow of electrical current, which may be very small in magnitude. But it carries metal ions with it and eventually causes a hole in the pipe line.

Because electrical current is the cause of corrosion, a basic law of current flow can be used to prevent the corrosion. This law is that current cannot both enter and leave a conductor, such as a pipe, at the same point at the same time. Thus we can, stop the corrosion current from leaving the pipe by causing a flow of greater magnitude into the pipe.

Sacrificial Anodes vs. Rectifiers. The corrosion mitigating current we are primarily interested in is DC. There are two sources of this current generally used: sacrificial anodes such as magnesium and an impressed current installation. The latter basically does the same thing as a magnesium anode installation except that currents of greater magnitude are pushed through the earth to the metal by a higher voltage source.

As both methods are effective, the decision as to which to use in any given case will depend usually on the economics of the individual situation. Magnesium anodes are usually best for short sections of coated lines, at "hot spots" on bare lines or in highly congested areas.

For most coated lines, rectifiers are usually the most economical. The exception is the section too short to justify the cost of installing a rectifier. On bare lines where only "hot spots" are to be protected, rectifiers do not have enough spread to be economical. Here, magnesium anodes do a good job. If the entire bare line is to be protected rectifiers would probably be best. In areas where there are a lot of foreign structures—as in towns and oil fields—rectifiers may cause interference to such a degree that magnesium anodes are more desirable.

As long as interference is not a problem, the use of magnesium anodes

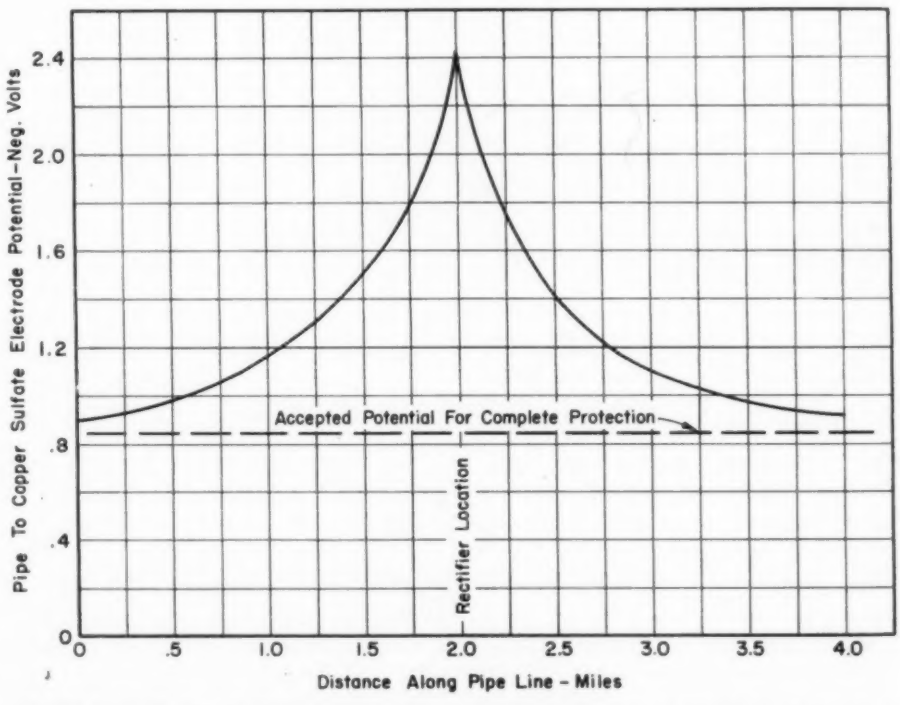


FIGURE 1—Potential along a pipe line in the vicinity of a rectifier. There is a current waste in the immediate area, and this is one of the many factors to keep in mind when making decisions as to type of protection and location.

vs. rectifiers can be settled by calculating the cost of three installations of magnesium anodes with a 10-year life per installation (30 years) and comparing the total with the cost of one rectifier installation plus estimated power cost and maintenance cost for a 30-year period. When making calculations and tests, it is well to remember that with a rectifier there is a waste of current in the area where the unit is located as can be noted in Figure 1. If magnesium anodes were used along this section of line there would be a series of little peaks at every anode, but the highest peak would be approximately one volt and the total current necessary would be less. It is important then that current requirement calculations for rectifiers not be based on the same amount per square foot of pipe as those for magnesium when comparing the two.

If from calculations it appears that rectifiers will be most economical a few other items need to be considered:

1. Will the unit be located in such an area that it will cause interference to other structures?

2. Is there a power source available?

3. Will it be possible to purchase the necessary right-of-way?

At river crossings or other inaccessible places where the cost of repairing or replacing a pipe line is extremely high, management will usually consider a rectifier as cheap insurance. At all other places a satisfactory payout must be shown for any installation.

Impressed Current System Elements. The rectifier, or impressed current, installation consists of two major parts as shown in Figure 2. Part (A) is the power source, usually a rectifying unit which can change AC to DC. The widespread use of these units has been made possible by the enactment of the Rural Electrification Administration law. Power is now readily available at practically every area where there is a need for rectifiers.

Before the REA program the major source of power came from generators. Many wind driven and gasoline driven generators as well were used. It was found that the cost of maintenance was extremely high and in general they did not operate satisfactorily. This was especially true with the wind driven units where you couldn't depend on a steady wind over the entire year.

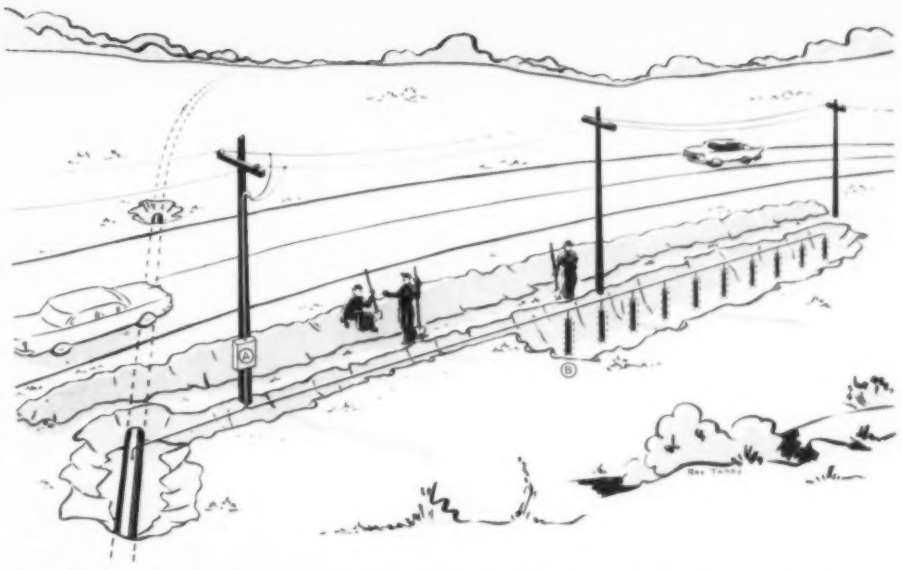


FIGURE 2—A rectifier or impressed current installation. Pipe line is at left; power source feeds into rectifier "A" and on to ground bed, "B". Selection of ground bed can mean a big savings or big loss in power bills.

The current from the power source is delivered to the earth through a ground bed (Part B, Figure 2). The ground bed must have a low contact resistance with the earth allowing large amounts of current to be discharged with the least effort. Originally most ground beds consisted of scrap steel such as pipe or railroad rails which gave a good low resistance contact with the ground, but the life was not as good as is obtainable with graphite or high silicon cast iron rods.

Let's take a look at each part of an impressed current installation. Figure 3 shows a pole mounted air cooled rectifier, but in many cases the unit is set on a concrete pad, especially if it is an oil immersed unit. The oil immersed unit is used primarily in areas where atmospheric corrosion is a problem or where high temperatures require oil for better cooling.

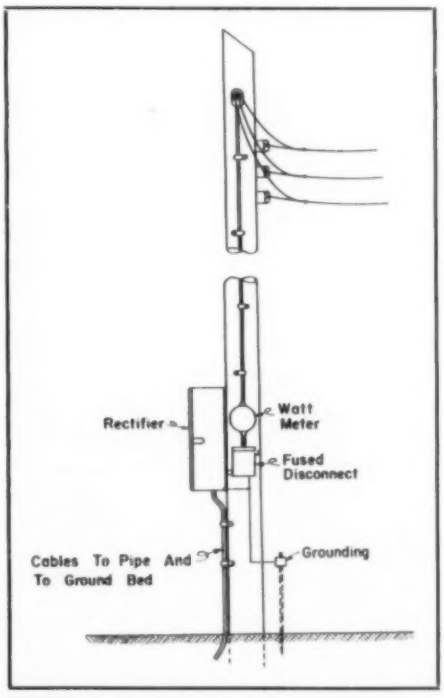


FIGURE 3—Pole-mounted rectifier unit. Note that the rectifier is grounded to the power company's grounding system.

The incoming power at the top of the pole comes down to the watt hour meter and then through a fused disconnect where the power to the unit can be cut off during maintenance work. From this point the power feeds into the unit itself and out through the cables at the bottom to the ground bed. Note the grounding system which is usually connected to the power company ground, but of equal importance is the connection to the rectifier box as protection against such things as a grounded transformer. Occasionally a lightning arrestor is installed in the AC circuit either at the top of the pole or at the switch box.

The electrical circuit inside the rectifier box is shown in Figure 4. The AC leads from the fused disconnect go through a protective breaker into the primary side of the transformer where the voltage is stepped down from 110, 220 or 440 to the proper amount in the tapped secondary side. Usually the taps are such as to make it possible to get about 20 DC voltage steps between zero and full rating.

Next are the full wave stacks which are designed so current through the load always flows in the same direc-

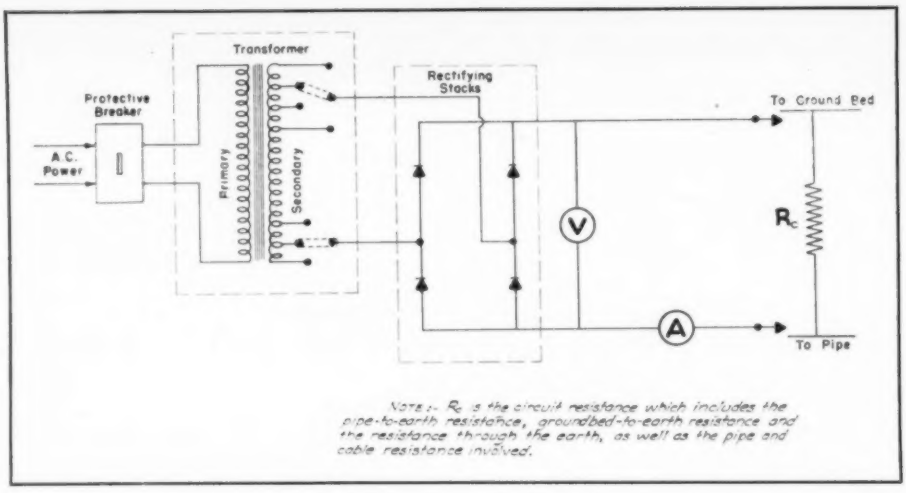


FIGURE 4—Schematic of the rectifier installation. Rectifying stacks simply eliminate lower part of AC cycles giving a pulsating DC flow. Sometimes filters are necessary to smooth out DC current and prevent interference with nearby telephone lines.

tion. The pulsating DC flow is in the direction of the arrow head only; therefore on each half cycle of the AC there is one path for the current to flow to give the right direction at the load. The earlier stacks in rectifier units were copper oxide which have given way to selenium stacks in today's units. A more recent development is silicon stacks which give better efficiencies but are very sensitive to surges. Additional protection devices are being used with the silicon which appear to do the job and if successful the silicon will probably replace the selenium in cathodic protection rectifier units. Other features of the rectifier unit is the DC voltmeter and ammeter for measuring the output of the unit. The positive cable is connected to the ground bed and the negative cable to the pipe line.

In certain parts of the country, one-wire telephone systems are still in use and the pulsating DC current from a rectifier can cause a humming on the telephone line. This interference can be cleared up to a great degree by the use of a filter. A filter consists of a choke in series with either DC lead and a capacitor connected across the output terminals. In addition to eliminating interference, a filter also smooths out the DC current, increasing the conversion efficiency. **At locations where high power bills are anticipated, the use of a filter can reduce the power cost considerably and a payout of less than a year can be realized.**

Circuit Calculations. The watts output of a rectifier depends entirely on what is called "circuit resistance." This resistance is the total resistance in the DC side of the installation which is primarily the contact resistance to earth between the pipe and ground and between the anodes and ground and through the earth itself. The power bill is a function of this resistance as the power consumed in the ground bed is:

$$P = E \times I$$
watts volts amps

The DC current (I) is a constant quantity depending on how much is needed to protect the system to which it is applied. The DC voltage (E) varies depending on the circuit resistance. By Ohms Law, $E = IR$, therefore $P = I^2R$.

If a 2 ohm ground bed is installed the power used would be twice that of a one ohm ground bed. It therefore stands to reason that it is economical to take time to get a ground bed with a low circuit resistance. One of the contributing factors towards a low resistance ground bed is the soil resistivity and detailed tests should be made to find the places where it is the lowest. A bed in 4000 ohm-cm soil could easily cause the power bill to be eight times that of a bed in 500 ohm-cm soil. The resistance also depends on the length and diameter of the anode and of the backfill it is in. Such things as whether the anodes are horizontal or vertical and the depth to which they are buried can affect the resistance.

Also, when anodes are spaced too close together there is interference between anodes which restricts the current flow from the ground bed and increases the resistance. Some typical ground bed installations are shown in Figure 5, while Figure 6 shows a deep well installation which is used where right-of-way is hard to obtain or where permanent moisture is deep. The number of anodes in a ground bed will be a factor in the circuit resistance as shown in Figure 7. The resistance with one anode is 3.5 ohms, with 6 anodes it is 1.5 and it is 1.0 ohm with 13 anodes.

As anodes are installed the circuit

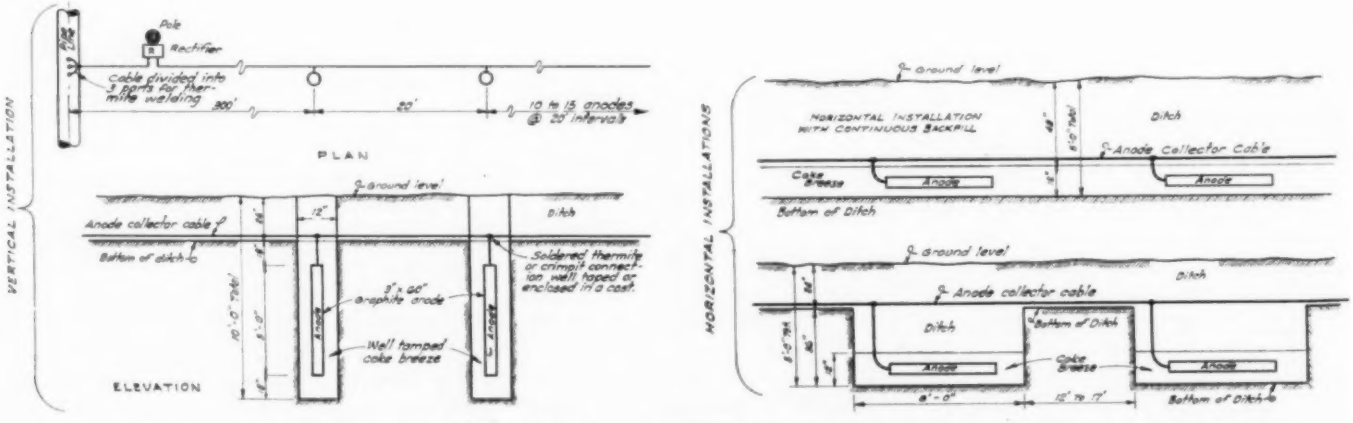
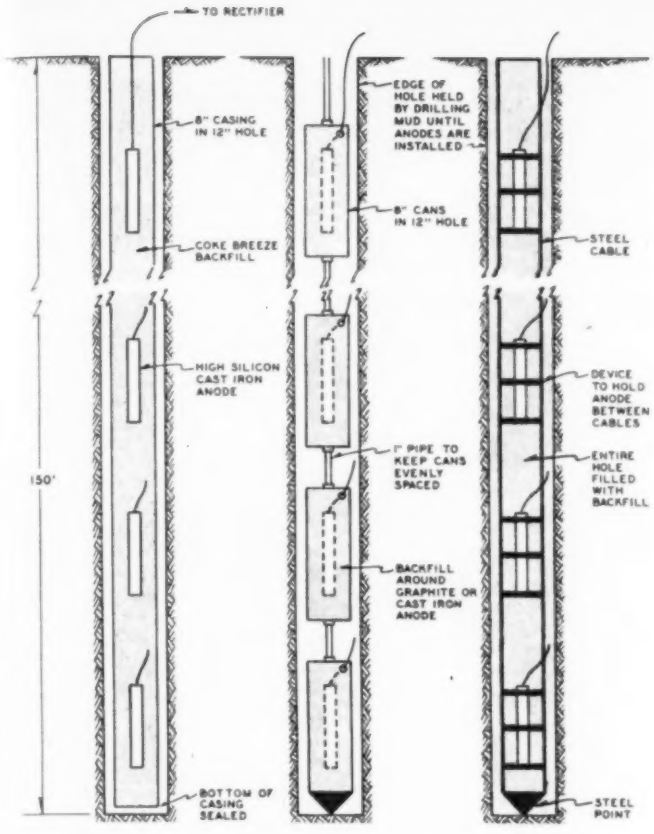


FIGURE 5—Typical installations of 3-inch by 60-inch graphite anode ground beds. Resistance of ground beds is important.


TO RECTIFIER
8" CASING IN 12" HOLE
COKE BREEZE BACKFILL
HIGH SILICON CAST IRON ANODE
150'
BOTTOM OF CASING SEALED
EDGE OF HOLE HELD BY DRILLING MUD UNTIL ANODES ARE INSTALLED
8" CANS IN 12" HOLE
1" PIPE TO KEEP CANS EVENLY SPACED
BACKFILL AROUND GRAPHITE OR CAST IRON ANODE
STEEL CABLE
DEVICE TO HOLD ANODE BETWEEN CABLES
ENTIRE HOLE FILLED WITH BACKFILL
STEEL POINT

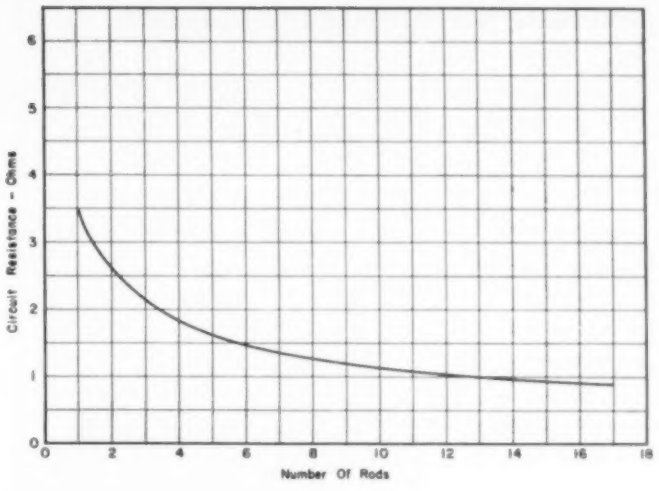


FIGURE 6—Using deep well for ground bed (left). This is necessary when lowest resistance is found at deeper Levels. Each lead wire from each anode must be carried to the surface in this type installation.

FIGURE 7—Choosing the number of anodes in a ground bed (above) is an important factor in the circuit resistance. The resistance with one anode is 3.5 ohms; with six it is 1.5 and with 13 anodes it is 1.0 ohm.

resistance can be measured as each one is connected to the collector cable. When the addition of the next anode does not appreciably change the circuit resistance, additional anodes are useless unless they are needed to insure that their current ratings are not exceeded. Also, in areas that tend to be dry, it would be wise to keep the drain per anode low in order to prevent excessive heating at the anode which will dry out the surrounding ground thereby causing the circuit resistance to increase.

If an entire line is to be protected with rectifiers, much study should be given to the location of existing power sources, foreign structures, the accessibility of the unit and the soil resistivity. The units should not be so close together that the power consumed is less than the minimum power bill. Also, if the units are too far apart, their output will have to be extremely high to get the same protection. This will invite trouble through interference to other structures, therefore the added spread would be costly.

After the size of a rectifier has been determined other factors must be taken into account before ordering the unit. On units above 20 volts, very little efficiency is lost due to operating them at undervoltage and the efficiency actually increases when operating the unit at slightly less than the rated current. When a unit is operated above the rated current, the only harm done is a decrease in the life of the stack; but on the other hand, it is very harmful to the unit if it is operated above the rated voltage by as much as 10 percent.

Rectifiers should be checked regularly, possibly once a month. A good check on units that are operating is the look, feel and smell test. If the unit is not operating, start checking with the incoming power and proceed through each component measuring voltages. This will readily pick up such troubles as power failures, arrestor breakdowns, blown fuses or tripped breakers, transformer failure, faulty meters, shorted stacks or ground bed failure.

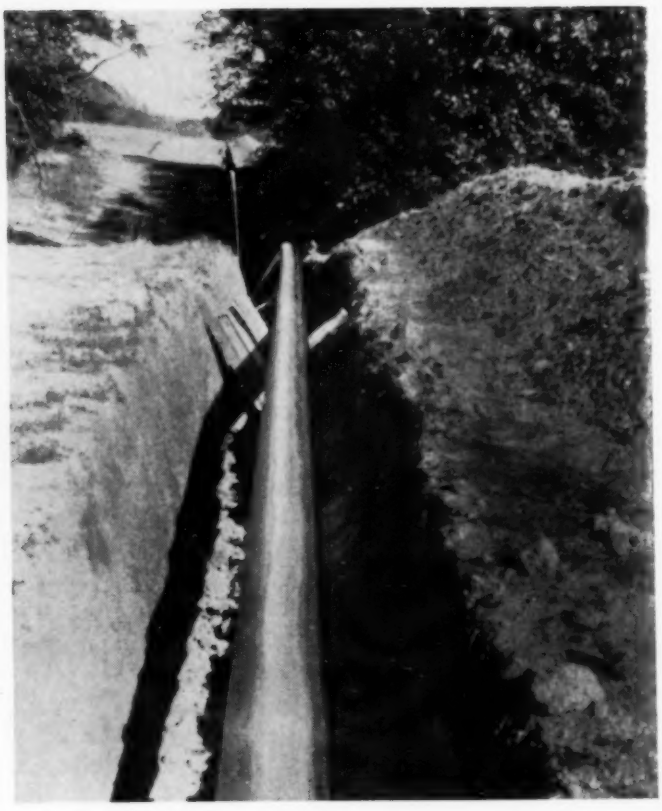
If a cable in the ground bed fails, pipe to reference electrode potential measurements can be used to determine the location of the break. From the time a rectifier is installed a record should be kept of every reading with efficiency checks made at intervals. A quicker check that can be used is to have a clamp-on ammeter and measure the AC current to the unit each time the unit is read. These readings will give a good indication of the units' operation as any variation of consequence from the normal pattern will mean the unit should be checked closer by other means.

Because of the large investment in the underground structure, a unit not operating is costing money due to loss of metal through corrosion; therefore, a good maintenance program is essential. It is wise to keep in stock those components which take considerable time to obtain and which are necessary for operation of the unit, such as the transformers and stacks. The stock will be held to a minimum if unit sizes can be standardized. —**The End**

About the Author

William A. Hutchison is senior electrical engineer for Sinclair Pipe Line Company, Independence, Kansas. He has been engaged in corrosion work since joining Sinclair in 1949. He holds a B.S. in electrical engineering from Oklahoma State University and is a member of NACE. Hutchison directs the corrosion control program in the Mid-Continent area under the supervision of the chief electrical engineer.

Only three men were required in the cleaning and coating of a six-mile section of 10-inch products line with cold applied mastic. The mastic traveled along in a 55 gallon drum on a skid behind the tractor. A transfer pump sprayed the coating onto the pipe.



Ready for lowering-in, the pipe has been repaired, cleaned and coated while it continued to operate.

How Marathon Applied Cold Mastic to A Products Line in Service

Pits on the old line were welded up or plated; and then three men cleaned the line and applied mastic at the rate of 1500 feet per hour

JUST BEFORE WATER began filling the new Mansfield Reservoir on the scenic Wabash River, 25 miles above Terre Haute, Ind., Marathon Pipe Line Company took steps to recondition and relocate sections of its 10-inch products line which would soon lie in the path of the flood control and recreation waters. The trickiest part of the job was repairing a 6-mile length of the line while it continued to operate.

The 10-inch line is part of a system that runs from Wood River, Ill., to Marathon's Clermont Terminal near Indianapolis, Ind. It was constructed in 1939, and over the years the .307-wall pipe sustained a certain amount of pitting. When the 6-mile section of pipe was uncovered and cleaned, welders welded up pits 120 to 175 mils in depth. Deeper pits and concentrations of small pits were plated over, or "half-soled."

This work and subsequent cleaning, coating and lowering-in were carried out on the 6-mile section of the line while it was in full operation. Because of the danger of fire, Marathon decided to use a cold applied mastic coating. The solvent-cast coating contains several resins which form a flexible pipe coating highly resistant to electrolytic action. In addition, it is gasoline resistant.

One of the advantages of the cold applied mastic is that the cleaning and coating equipment is light, and it takes a minimum crew. In this case, Marathon was able to coat as much as 1,500 feet of pipe in an hour using a three-man crew.

A special coating machine was used in conjunction with a light weight cleaning and wrapping machine. A small transfer pump supplied the coating material from a 55-gallon drum pulled on a sled along the right of way. Another important feature of the coating machine was that it could traverse the half soles on the line.

A glass outer wrap was applied simultaneously; in most cases the pipe was lowered-in immediately after coating.

ACKNOWLEDGMENT

Photos courtesy of L. G. Royston, Royston Laboratories, Inc., Pittsburgh.

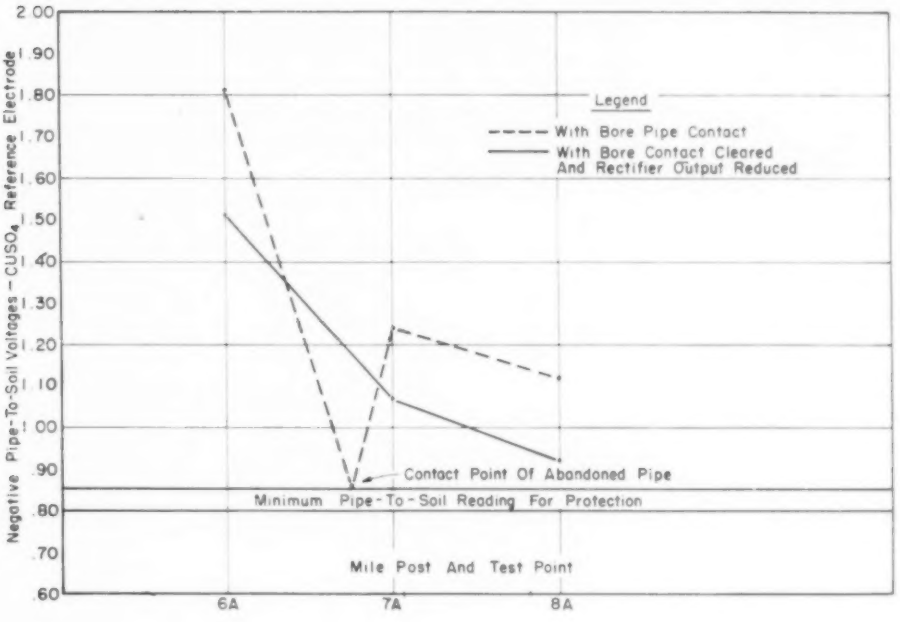


FIGURE 1—Pipe-to-soil potentials before and after a contact with an old abandoned line was removed. Before the old line was discovered, corrosion engineers had trouble explaining the variation in instrument readings which sometimes occurred hourly.

Old Abandoned Pipe Line May Be a Source of Corrosion Trouble

How to spot these trouble makers and what to do about them

By John Emery, Assistant General Superintendent
Rio Grande Valley Gas Company
Brownsville, Texas

TIME WAS when scrap steel wasn't worth much and badly corroded lines were simply abandoned in place. Many of these old lines have gone—but they haven't been forgotten. They can cause too much trouble for corrosion engineers.

Many of the old gas lines were bare pipe with mechanically coupled joints. Through the years leakage developed, and in many instances, operational costs became prohibitive, and they had to be replaced. Prior to World War II, the value of old pipe lines of this type was not great; the cost of salvage more often than not exceeded their value. Under these circumstances, the pipe lines were simply abandoned in place. Often, they were replaced with coated and wrapped steel pipe laid parallel to the old lines —sometimes in the same ditch.

This practice proved to be a source of corrosion problems. Where the mechanical couplings on the old line actually contacted the new line, the resulting corrosion became a function of soil resistance, resistance of contact between pipe junction and potential difference between the two underground metal structures.

Sometimes these contacts are intermittent, depending upon moisture content of the soil, etc. This makes them difficult to find. If cathodic protection is applied to the new, coated line, a large drainage current will occur at this contact point when contact is being made. The amount of current required to protect coated pipe in contact with bare pipe may be in the order of several hundred percent higher than the amount required to protect the coated pipe when the bare pipe contact is removed.

Here's a case in point: An 8-inch gas transmission line belonging to Rio Grande Valley Gas Company, located between Brownsville and San Benito, Texas, made contact with a section of abandoned bare 8-inch pipe line.

Pipe-to-soil readings along this line, as shown in Figure 1, indicated a current drainage of considerable magni-

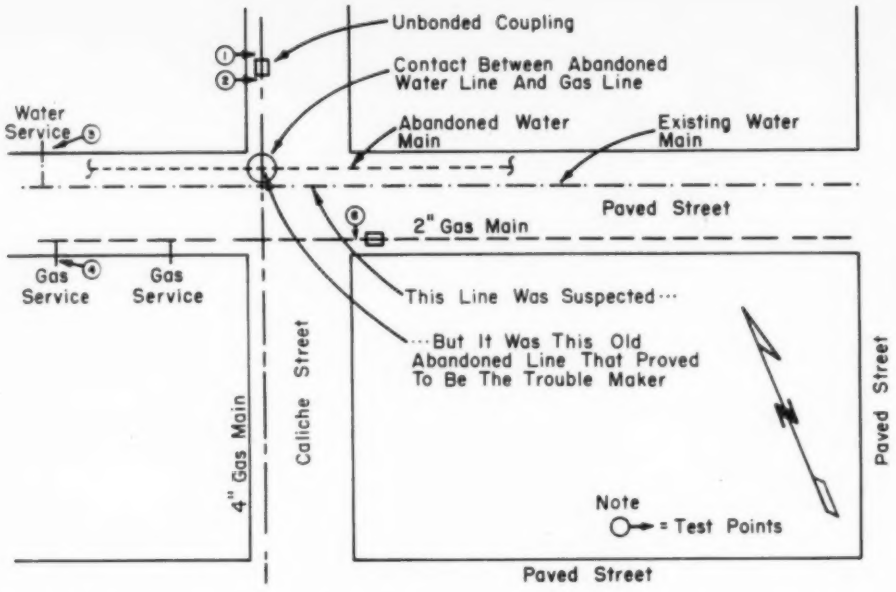


FIGURE 2—An old abandoned water line caused considerable head scratching before it was discovered. The city had no records of its abandonment.

tude. This 8-inch line in service was under cathodic protection with current being supplied at this point by a transformer-rectifier. Pipe-to-soil readings along this line in this area fluctuated and were variable over short periods of time. All rural taps were insulated. It was concluded that the line was in contact with a foreign line, although there were no known crossings in this area.

Pipe-to-soil readings taken along the line narrowed the search to a short stretch of pipe, and the line was excavated at this point. Digging disclosed a bare compression-coupled 8-inch line parallel and adjacent to the coated and wrapped line! A check of records indicated that 800 feet of pipe had been replaced in this section in 1939, with the old pipe being abandoned.

A short distance down the line, the line in service crossed above the old line and the weight of the new line had forced the sharp edge of a coupler on the old line through the coating on the bottom of the new line and was making metallic contact. Cathodic protection current was being drained to the old line from the new line with a subsequent lowering of potential of the line in service. Removal of two joints of the old pipe at this point eliminated the contact and permitted a decrease in the output of the rectifier. Pipe-to-soil readings after this work was completed are also shown in Figure 1.

It was interesting to note also that past leak repair records on this new line showed a rash of leaks in this vicinity before cathodic protection was applied to the line in the vicinity.

Figure 2 shows another source of trouble for pipe lines laid in corporate city limits. An abandoned 2-inch bare water line under a paved street in a gas distribution system came in contact with a 4-inch low-pressure gas main. Cathodic protection was applied to this distribution system by means of magnesium anodes, but as the pipe-to-soil readings in Table 1 indicate, protection was not being obtained on the system at this point, and an accidental contact seemed likely. Because both gas and water mains were in the street, the water line was suspected. However, pipe-to-soil readings on the water meters did not indicate this to be the case. The gas main was followed, using a heavy-duty pipe-locater and an indicated "short" was found under the pavement at an intersection.

The pavement was cut at this point (Figure 2) and revealed the gas main was in contact with an abandoned 2-inch water main. This old main had been abandoned by the city and a new line laid prior to paving the street in a residential section. A length of this pipe was cut out of the abandoned line and readings (pipe-to-soil) came up to a point well above protection as shown in Table 1.

One joint of abandoned pipe can be a very troublesome item to the corrosion man especially if good records are not kept of pipe line abandonments.

Of course, the problems of abandoned pipe in gas distribution systems are multiplied because you not only have your own abandoned pipe, but that of others, such as old bare water lines to contend with. These sometimes are very difficult to locate and require considerable analysis and exploration.

Most pipe line and distribution companies have little control over abandonments by others, but a little foresight in your own pipe line abandonments may save considerable difficulties in later corrosion control work. —**The End**

TABLE 1—Pipe-to-soil readings before and after the contact in Figure 2 was cleared.

Test Point Number	Pipe-To-Soil Readings At Test Points	
○⟶	Before Contact was Eliminated	After Contact was Eliminated
1	1.15 Volts	1.15 Volts
2	.71 Volts	1.11 Volts
3	.46 Volts	.46 Volts
4	.71 Volts	1.11 Volts
5	.73 Volts	1.09 Volts
6	.68 Volts	1.11 Volts

About the Author

John Emery is assistant general superintendent of the Rio Grande Valley Gas Co. He graduated from Texas College of Arts and Industries in 1946 with a B.S. in natural gas and petroleum engineering. The same year he started work for Rio Grande. Since 1950 he has been in charge of the company's corrosion mitigation work. Emery is a member of NACE.

Batching Two-Phase Flow with Spheroids

Fully automatic pigging with multiple sets of spheres skyrockets the efficiency of a 40-mile gathering system of 16, 18, 20 and 24-inch lines. Recovers 1,000,000 gallons of gasoline in two months

By David W. Bean,
Senior Engineer

and H. Norman Eagleton,
Project Engineer, Colorado
Interstate Gas Company
Colorado Springs

LAST NOVEMBER construction was completed on a unique pigging system that holds great promise for the natural gas industry. Colorado Interstate Gas Company initiated "on-stream" pigging of a 40-mile gathering trunk system of 16, 18, 20 and 24-inch lines. The fully automatic pigging with spheres not only increased the efficiency of the system, but also produced more than 1 million gallons of salable gasoline during the first ten weeks of operation.

History. The gathering system for the Mocane and Laverne fields in the Oklahoma Panhandle had been developing over a period of 2½ years. A difficult problem in designing any new natural gas gathering system is determining the quantity of condensation which must be handled and how to handle it. This condensation collects in each of hundreds of sags inherent in a pipe line crossing a rolling country-side. The gasoline in each sag then becomes a bubbling impediment to gas flow.

Anticipating the potential of "on-stream" pigging, Colorado Interstate engineers designed the system in early 1957 with a minimum number of drips. Full opening valves were installed in major trunk lines.

That fall, in an unprecedented move, field personnel were instructed to lock all drips. The objective was to determine whether or not the normal gas flow would convey the liquid through the line. Gasoline began to accumulate throughout the system. Spot checks, during the winter, revealed 2 and 3-mile sections of pipe line in rough terrain with pressure losses as high as 25 psi. This com-

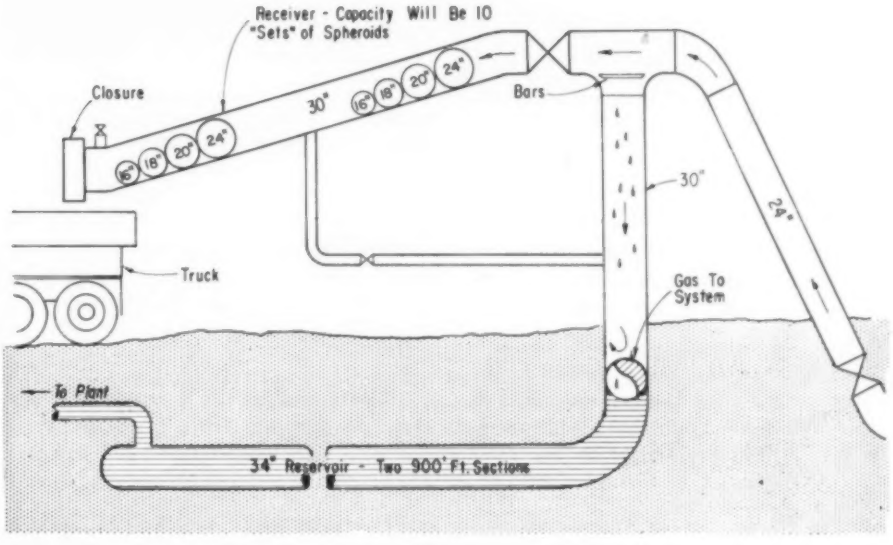


FIGURE 1A—Receiving barrel and gasoline-gas separator at the end of the 16, 18, 20 and 24-inch gathering system in Oklahoma. In two months run (December and January) this "separator" recovered over 1 million gallons of gasoline. Here's the way the receiver works. Liquid arrives first, falls down into gas piping and on to "reservoir". Spheres pass over bars into receiver which now holds 16 spheres (four sets). Gas goes on into system, and small diameter line takes gasoline to nearby plants.

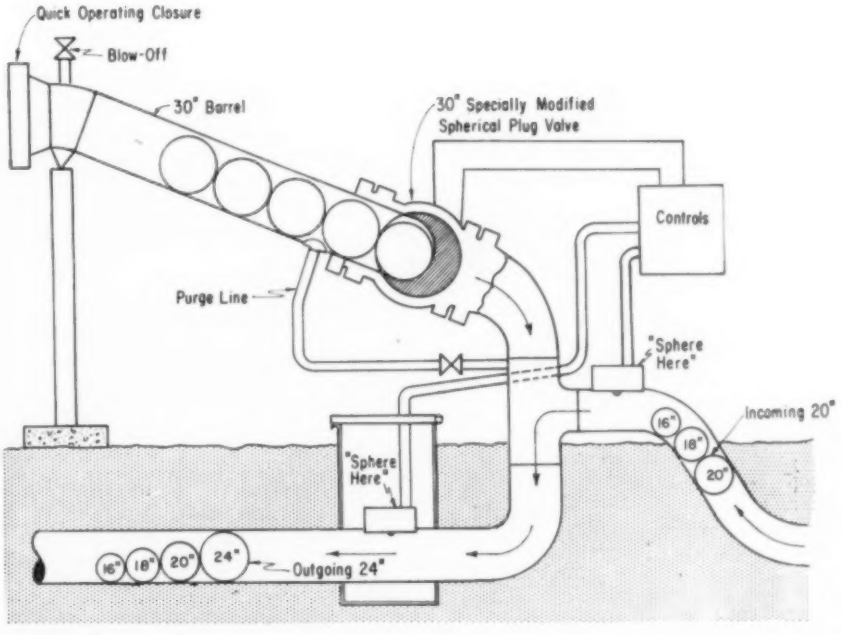


FIGURE 1B—How the spheres are launched. Incoming spheres of smaller diameter trip sphere detector which actuates pneumatic signal to specially modified spherical plug valve. This valve rotates 180 degrees and lets one sphere (24-inch in this case) fall down into the pipe line. Gas sweeps the sphere into the 24-inch pipe line following the 16, 18 and 20-inch spheres that went before. As the 24-inch sphere leaves it trips a second sphere detector which causes the valve to rotate 180 degrees back to its original position.

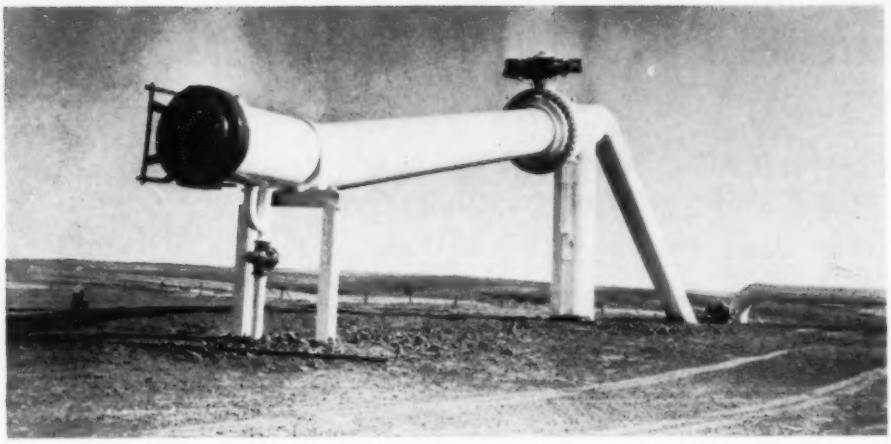


FIGURE 2—Receiving barrel for Colorado Interstate's automatic gathering line pigging system. New barrel to be installed will hold 10 sets or 40 spheroids. The company has been carrying out pigging every other day; the operation is entirely automatic.

pares with 2 psi for normal pipe line efficiencies. But, by the spring of 1958, only insignificant quantities of condensate had reached the central scrubber.

New information on two-phase flow presented by Orin Flanigan, Arkansas Louisiana Gas Company, explained the reason. Gas velocities in the pipe line were too low to sweep the liquid over each hill. He presented equations that would permit calculation of the probable pressure drop required to convey the liquid through the pipe line.

Calculations indicated that a change in operation of facilities would be necessary soon. They proved to be correct. In January 1959, when pressures near the wells approached the maximum operating pressure, rupture discs were breaking, relief valves were popping. The pressure continued to increase despite frequent drip blowing.

"Operation Sweep" provided temporary relief until facilities could be designed and installed. This provided relatively high gas velocities to sweep gasoline forward to the plant where the condensate was recovered. By special arrangement delivery pressure was reduced so that gathering system pressure could be lowered. High pressure gas (800 psi) was then surged into the downstream sections at 200 to 300 psi, and liquid was swept forward. "Operation Sweep" recovered 110,000 gallons of gasoline and reduced pressure at the distant wells by 125 psi.

Possible solutions. By this time a composite analysis of the gas was available and condensation could be accurately calculated. All pipe lines had been profiled. Probable pressure drops were calculated at various flow rates for most sections of the gathering system. The problem was better defined.

Several methods of solving this problem have been utilized with varying degrees of success in the past. The most common is installation and maintenance of numerous drips within a system. Other common methods incorporated include installation of field compression; parallel liquid gathering systems; and more recently, "on-stream" pigging.

Colorado Interstate engineers selected "on-stream" pigging as the best method for removing the gasoline. Their objectives were to improve the flow efficiency, recover a high volume of liquid hydrocarbons at one central point for sale to the Warren gasoline plant nearby and, at the same time, hold investment and operational costs to a minimum.

The use of a pipe line spheroid, described by M. L. Barrett, Jr., Shell Oil Company (October 1959, PIPE LINE INDUSTRY), helped in recommending the solution. The pipe line spheroid effectively and economically

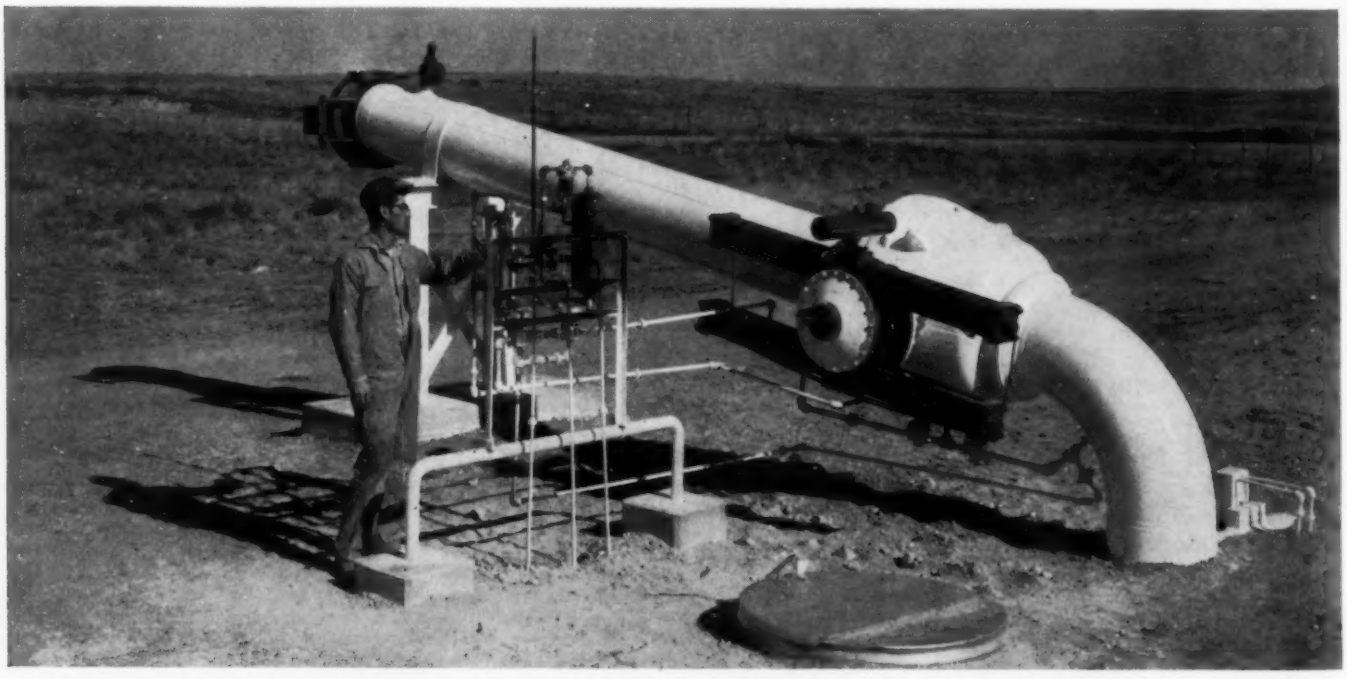


FIGURE 3—Launcher. Schematic in Figure 1B explains how it works. The hydraulic rams on the spherical plug valve rotate it 180 degrees to launch a sphere and as the sphere leaves the valve, returns at a signal from a trip inside the line.

displaces liquid and could be easily manipulated by automatic equipment.

Little sphere—big sphere? Sphere behavior and liquid removal efficiency were tested in a 6-mile section of 8-inch pipe line. A 6-inch sphere surprised everyone by steadily traversing the uphill sections of the 8-inch pipe line, reducing the pressure drop by 50 percent while removing a substantial amount of liquid. A sphere sized to 97 percent of pipe inside diameter provided almost 100 percent liquid removal. Pressure differential required to propel the smaller sphere was substantially less. The "loose" fit required 1 psi in line pipe and 5 psi in a river crossing of reduced pipe inside diameter. The "tight" fit required 5 psi and 12 psi in these same pipe sizes.

System design. Because the line sizes vary, starting with a 16-inch and running progressively to 18, 20 and 24-inch, it was obvious that any type pigging had to be a multi-unit operation. Had regular squeegee pigs been used, each change in line size would have required a receiver barrel as well as a launcher. But the method finally decided upon, eliminated all but one receiving barrel in the system, and simplified the entire operation.

Launchers were installed at the start of each size of pipe line run. The 16-inch sphere is launched by a time cycle controller. Progressively larger diameter spheres are launched automatically behind it as line sizes increase. In other words, line cleaning starts with the launching of a 16-inch sphere at the upstream end of the 16-inch line. Where the line swages up to 18-inches, an 18-inch sphere is launched right behind the 16-inch one; and so on until a 24-inch sphere is launched behind the 16, 18 and 20-inch spheres.

These spheres, propelled by the gas behind them, push the liquids to a large "separator" near the company's scrubbers at the Mocane site. At this point all four neoprene spheres are collected in a receiver barrel while the liquids collect in two 34-inch lines, 900 feet long and the gas goes through the scrubbers and on to the Warren gasoline plant. The liquids are piped also to the gasoline plant at field pressure. The entire pigging operation takes place in 8 to 12 hours.

Launcher design. Utilizing the force of gravity, a sphere will roll down a launching barrel if the barrel is large enough and has sufficient slope. Storage barrels and launching valves were sized up to the next larger standard valve size. The 16-inch and 18-inch spheres required 20-inch barrels; the 20-inch required a 24-inch barrel; and the 24-inch required a 30-inch barrel. With this clearance, experiments indicated the spheres would roll dependably if the storage barrel was inclined 5 degrees or more.

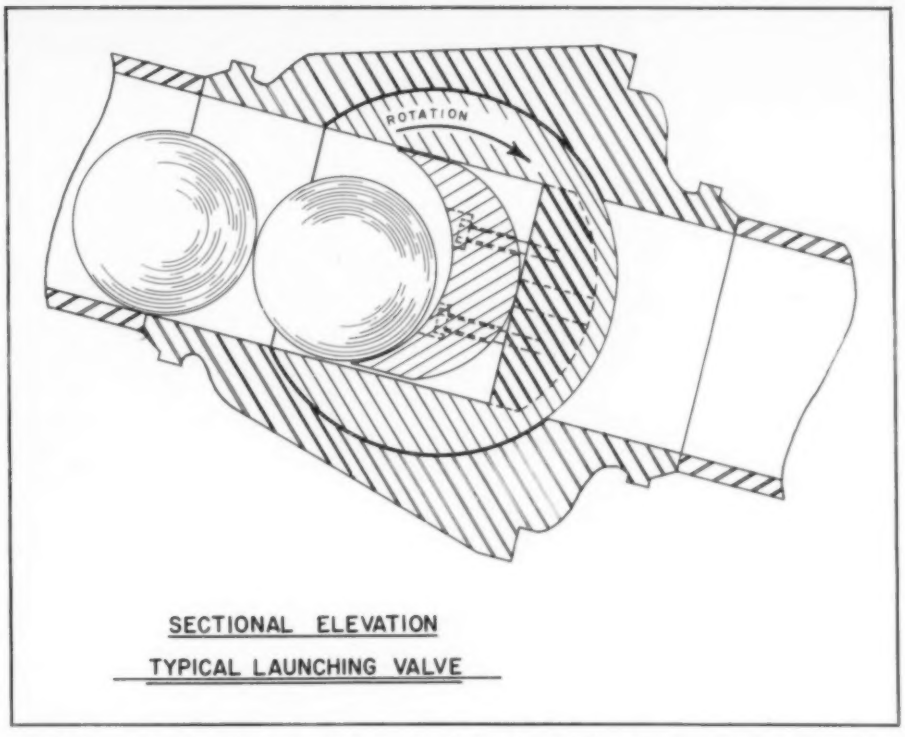


FIGURE 4—Details of the modified spherical valve. In its closed position it will allow one sphere to roll into its "basket." When it turns 180 degrees, it launches a single sphere.

The spheres roll into a specially constructed spherical plug valve. The valve and its operator were modified by two specifications. First, the through conduit opening in the valve was cast closed on one end. The resulting basket was sized to accept only one sphere at a time. Second, a standard plug valve operator was modified to rotate the plug 180 degrees.

At the 16-inch launcher, a pneumatic signal from a time cycle controller launches the sphere by rotating the special basket plug 180 degrees. The sphere rolls out of the valve and drops into the pipe line. After traveling a few feet, it actuates a sphere detector which extends down into the pipe line. The motion of the detector is utilized to transmit a pneumatic signal that returns the basket-plug to the original position, ready for the next cycle.

As the 16-inch sphere approaches the 18-inch launcher, it actuates another sphere detector which produces a pneumatic impulse that launches the 18-inch sphere.

Timing is such that each sphere will be launched only after the preceding sphere has passed the launcher. In other words, after the incoming 16-inch sphere trips the sphere detector, the launching valve starts its 180-degree rotation, allowing the 18-inch sphere to roll down by gravity through a 20-inch ell into the pipe line. Here the 18-inch sphere is swept ahead into the 18-inch pipe line, following close on the heels of the 16-inch sphere.

As the 18-inch sphere is launched into the pipe line, it trips a sphere detector which actuates a mechanism to return the launching valve to the original position, where another sphere rolls into it.

A similar operation takes place at the point the gathering system changes from 18-inch to 20-inch. The 16-inch sphere does not trip the detector because the arm extends an inch into the 18-inch line, but the 18-inch sphere behind it does trip the mechanism. This causes a 20-inch sphere to be launched, falling by gravity into the pipe line where it enters behind the 16 and 18-inch spheres. The same operation occurs at the point where the line size changes to 24-inch.

The capacities of each of the launching barrels is 10 spheres! And to start a line cleaning, a time cycle

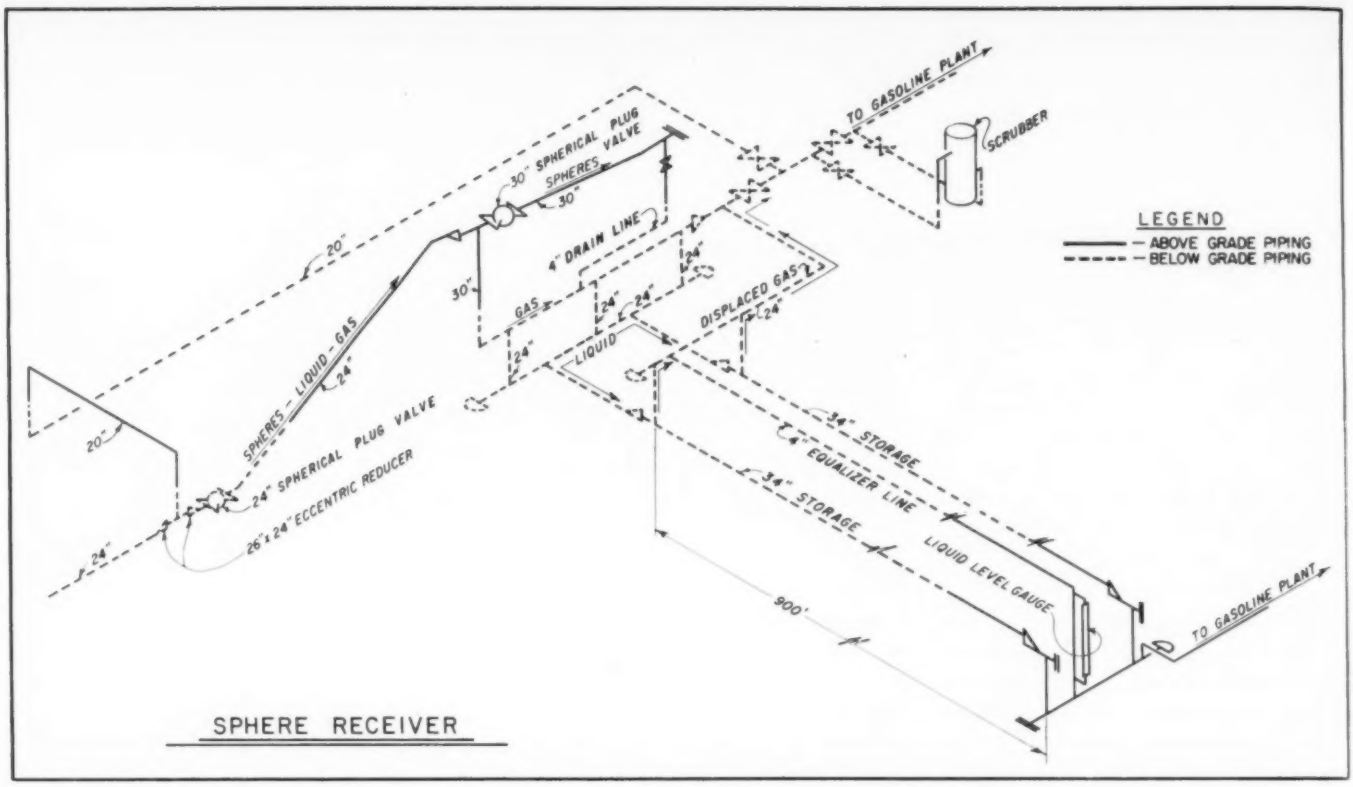


FIGURE 5—Schematic of the sphere receiver. Spheres and liquids come from the right. Liquid drops below through the 30-inch into the 24-inch and on into the 34-inch storage lines. From there it will flow to the nearby gasoline plant. Spheres roll into the barrel and gas goes into the Colorado Interstate system.

controller, set the previous day, launches the first 16-inch sphere. The rest is automatic.

Receiver design. At the receiving barrel, liquid hits in a practically continuous slug for several minutes. On one run, approximately 75,000 gallons of liquid collected in 13 minutes. If the liquid were removed from the system to atmospheric pressure at this rate, the required separating equipment would be either enormous or inefficient. Even more important, a gasoline plant or compressor station operating downstream of the removal facilities would be completely disrupted.

For this reason, high-pressure liquid storage was essential. The facilities were designed so that liquid could enter at the bottom of the liquid storage legs while the gas, displaced from the storage, vented into the main line. Operating equipment downstream from the facilities would receive the displaced gas and could continue normal operation.

Pushing the liquid, the four spheres —16, 18, 20 and 24-inch—come up over the vertical leg of the underground "separator." Bars across this leg prevent the spheres from dropping down into the reservoir and they roll on into the receiving barrel. The latter is sized to hold 16 spheres. The barrel will be lengthened to hold 40 spheres, or 10 complete runs.

Because the liquid enters in a huge slug, gas velocities in the double-barreled "separator" are extremely low. Therefore, the separating capacity of the 30-inch upper barrel is adequate. With gas flow rates in excess of 120 MMcf per day, the scrubbers downstream from the receiver have not collected detectable quantities of gasoline. While the liquid is entering the separator, the high gas flow rate is being furnished through the storage vent lines.

The liquid storage facilities have a capacity of 80,000 gallons. A 4-inch equalizing line and liquid level gages permit accurate gaging of the stored volumes. Collected condensate is transferred to the gasoline plant at an approximate rate of 10 gallons per minute.

Gasoline plant operation is not disrupted. All spheres fit snugly in the fabricated assembly piping and relatively loose in the line pipe, which comprises over 99 percent of the trunk lines. As an example: the 16-inch line pipe has an inside diameter of 15.50 inches and the 16-inch fabricated assemblies have an inside diameter of 15.00 inches. The actual outside diameter of the 16-inch sphere is 15.25 inches. With this type fit, the differential pressure across the sphere when it initially enters the line pipe is less than 1 psi.

However, as liquid accumulates ahead of the sphere, the differential pressure across the sphere and the liquid slug fluctuates as each hill is traversed. Basically, as the sphere starts up a hill, the differential will equal the liquid head being lifted up the hill plus a frictional head. When the sphere reaches the top of the hill the differential is equal only to the frictional head.

Field pressure is controlled by a back pressure regulator located downstream from the gasoline plant. Normally, this regulator is restricting flow. When the spheres reach the receiver, the regulator is thrown wide open to relieve the system of 20 to 25 psi line pack.

An analysis of meter charts recording gas volumes into the gasoline plant reveal important flow characteristics during a sphere run. First, the flow rates do not fluctuate more than 2 percent until the spheres reach the bottom of the long hill that slopes upward toward the receiver. The

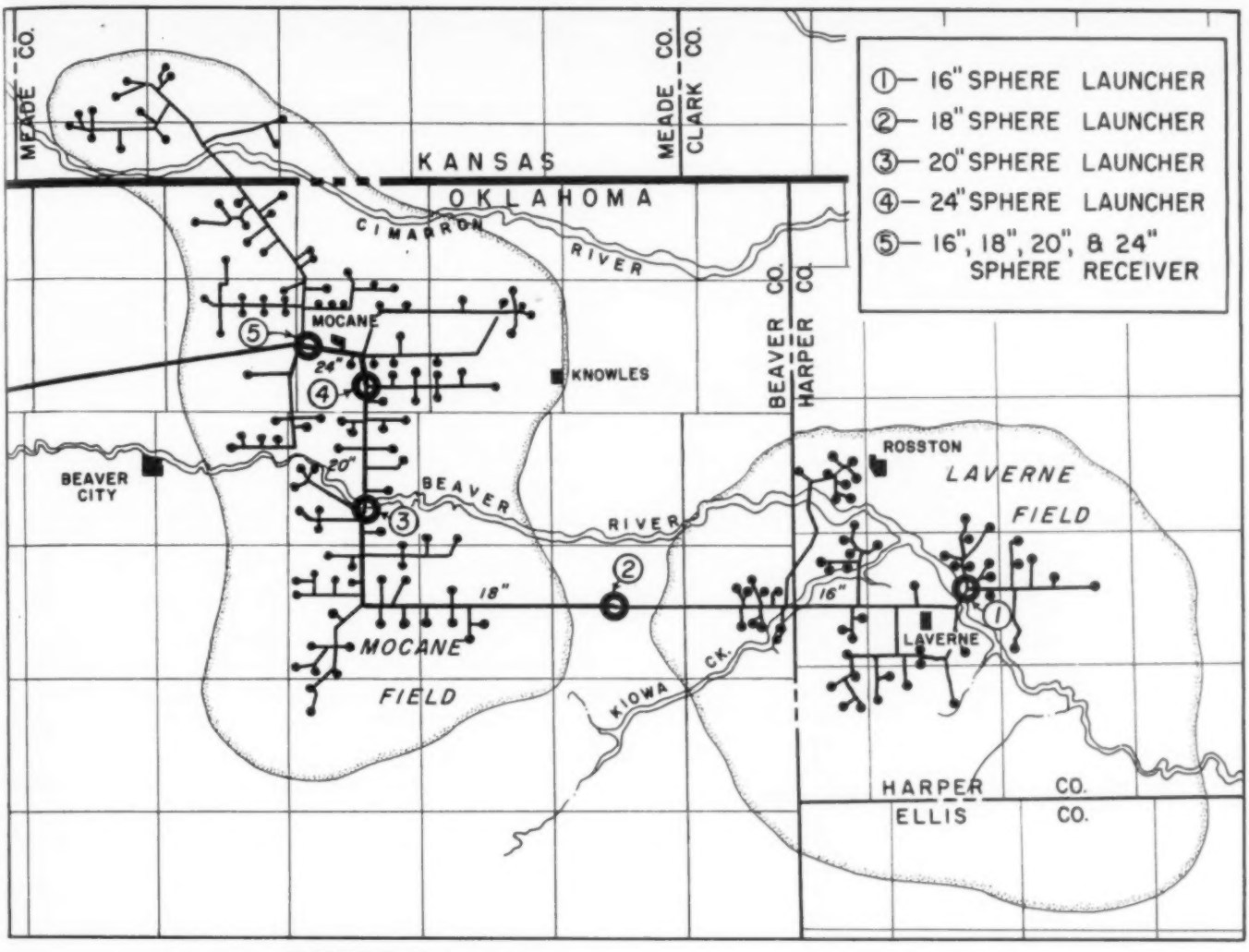


FIGURE 6—System map.

effective vertical height of the hill is 85 feet. At this point, the flow rate drops off approximately 5 percent. Then, as the spheres approach the receiver, the flow rate begins to rise. It reaches a peak when the spheres reach the receiver because, while the spheres are ascending the hill, both the liquid head and the frictional head are approaching zero. The peak is usually 10 to 15 percent above the average flow rate. From the peak, the rate gradually drops back to average in approximately two hours, which is the time required to relieve the line pack from the gathering system.

About the Authors

Bean

Eagleton

David W. Bean, Colorado Interstate Gas Company senior engineer, was graduated from the University of Oklahoma with a B.S. in chemical engineering in 1947 following his discharge from the U. S. Army as a captain. After two years in construction, he joined Colorado Interstate as a junior engineer. He has been active in designing and planning the spherical pigging system which is proving successful in the Oklahoma gathering system.

H. Norman Eagleton, project engineer on this operation, graduated from the University of Colorado in 1953 with a B.S. in mechanical engineering and a second degree in business marketing. After three and one-half years at the University of California laboratories in Los Alamos, N. M., he joined Colorado Interstate.

Economics—performance results. Cost of the entire project, including removal of 18 drips, was close to $300,000. Over half the cost, $170,000, is represented by the receiver, storage, and liquid meter station.

On November 16, 1959, the pressure at the 16-inch launcher was 900 psig. Three days later, with gas volumes essentially the same, the pressure stood at 790 psig. During this three day period approximately 170,000 gallons of gasoline were recovered from the system by the initial sphere runs.

During the months of December 1959 and January 1960, spheres were run every other day and close to 1,000,000 gallons of gasoline were retrieved from the system.

Immediately after pigging, line efficiency is normal. Gasoline recovery has exceeded predicted volumes slightly. "On-stream" pigging is now a part of standard operations.

ACKNOWLEDGMENT

Rockwell Manufacturing Company, Pittsburgh, Pa., modified the launching valves in accordance with specifications furnished by Colorado Interstate Gas Company's engineering department. F. H. Maloney Company, Houston supplied the spheres and the sphere detectors. The latter were modified to CIG specifications.

Pipe Line Pete's

IDEAS FOR THE FUTURE!

... in pipe line engineering, construction and operations

By Donald M. Taylor, Engineering Editor

Paint-On Epoxy Resin; New Rubber Coating Developed

A new insulating paint, made from epoxy resin, may hold much promise for pipe line station maintenance men. The new product—developed by Westinghouse Electric Corp. is some 300 times more resistant to breakdown by surface short circuiting than phenolic insulating materials now in use.

The new insulator can be sprayed or brushed on—20 mils of thickness is considered adequate for most switchgear installations in the 5,000 to 15,000 volt range. It requires no baking.

New Rubber Coating

A new rubber coating patterned after porpoise skin greatly reduces the skin friction of water. If successful, there is a possibility that the new material could have a pipe line application—as lining for pipe, pumps or coating for impellers.

Here's the principle of the new coating, which was developed by U. S. Rubber Co. and Coleman Engineering Co. of Los Angeles: A thin rubber sheet is supported by a multitude of tiny rubber pillars which are surrounded by a free flowing liquid. Turbulence outside the rubber sheet causes flow inside which to a degree counters the turbulence in the microscopic boundary layer in flow.

According to its developers, it reduces skin friction in water by about 90 percent.

New Organic Family Discovered; Asphalt Uses Exploited

Many new materials will come from perarylated silanes —a new organic system remarkable for its versatility, heat and radiation stability—according to predictions of Air Force chemists. The Office of Technical Services, U. S. Department of Commerce has just released the poop on this new line which many chemists will likely follow in the future.

Chemically the new chemical family can be described as combinations of silicon atoms and aromatic groups combined in various molecular arrangements. Some of the resulting products offer great promise in the fields of lubricants, electrical and insulating coatings.

New Products from Asphalt

Asphalt is cropping up in all sorts of new uses and new products. One of the most important is a combination of epoxy resin and a bitumen cut (between asphalt and bunker C oil). It makes a tough coating which may prove to be an equally tough competitor for existing underground pipe line coatings.

Husky Oil Co. and Du Pont have produced a combination of neoprene and asphalt which may prove to be an excellent paving material (as topping for ordinary asphalt).

Shell Oil Co. has combined asphalt with its epoxy resin to make heat resistant coating for asphalt paving.

But the most unusual product and use is a thin asphalt film developed by Esso researchers. The film will be sprayed over grass seed on the ground to preserve the moisture for five or six weeks until germination of the seed has taken place.

New Material for Corrosion Control and Insulation. A new sprayable polyurethane foam system, developed by Wyandotte Chemicals Corp., produces a rigid foam coating which is self-adhering, weather and chemical resistant. It dries in less than 5 minutes. Temperature range of the new product is said to excel in both high and low values.

Advances Announced in Electrical Field

Welding and cutting steel with a beam of electrons may be popular on pipe lines sooner than you think. Hamilton Standard Division of United Aircraft Corp. has obtained rights to manufacture such a machine which was developed by the Carl Zeiss Foundation in Germany.

The machine focuses a stream of high-energy electrons in an extremely small area. Temperatures as high as 11,000 F are reached at the contact point. A short distance away, the temperature will rise but little.

The device should be handy for cutting and also for welding steel.

Heat Converted Directly into AC Power

Many companies have been experimenting with means of converting heat directly into electricity—a number of them have been quite successful. But for the first time, one of the companies has converted the heat directly into AC power. Scientists at General Dynamics Corp.'s General Atomic Division announced that they converted heat into sufficient AC electricity to burn several small light bulbs.

A high temperature cesium cell converter which has no moving parts converted heat directly into 100 kilocycle AC power.

DC Current Stops Hemorrhage!

Looks like a welder would have thought of this first. Scientists at State University of New York Downstate Medical Center claim that thrusting an electrode into

accumulating blood and turning on the DC current will effectively stop hemorrhage!

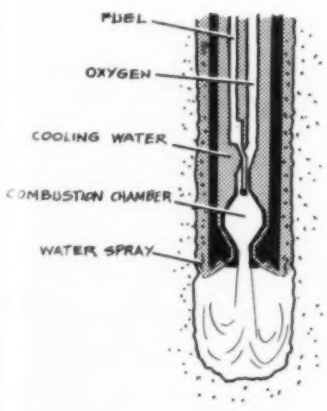
If this proves out, a DC battery or welding machine may replace the tourniquet. If it does, it'll sure change safety training.

Magnetohydrodynamic Generator—New Power Source

Magnetohydrodynamic Generator. This new device, developed by General Electric extracts electricity from the motion of ionized gas passing through a magnetic field. In this instance, air—heated to some 5,000° F to ionize it—is passed through a quartz tube in a magnetic field. Electrodes on opposite sides of the tube collect the current. Efficiency is low today, but engineers expect to achieve 80 percent or so in the future. Best possibilities for the pipe line industry—using it in conjunction with other power sources.

Ditching Rock With Flame?

It's possible right now! Not actually cutting the ditches with a flame—but drilling the holes. For some time, flame has been used to drill taconite—the extremely dense iron ore—and recently Linde Co. produced a "Stone Shaper." This device was used to cut away granite on New York's Queensborough Bridge.



Here's the way it works. Kerosine is combined with oxygen in the combustion chamber of a seven-pound cutting head. The chamber is cooled with circulating water; water also may be used to cool the rock surrounding the rock.

The flame shoots from the torch at a velocity of 7,000 feet per second at a temperature of 5,500° F. The intense heat causes the stone to spall off in tiny chips.

A modification of this inexpensive tool (price about $300) could be used to drill rock on the right-of-way. In very hard rock country this could prove economical—perhaps.

"We have Ford Trucks with 101,090 to 146,436 off-road miles and no major repairs"

says Mr. M. C. Kelsey
President
Rayflex Exploration Co.
Dallas, Texas

"Doing seismic work for the petroleum companies in their search for new oil fields takes our crews far from any road. Our trucks must follow a line cross-country, regardless of the terrain. And Ford Trucks come through where the others won't.

"We have 46 Ford Trucks from pickups to heavies. The Ford Pickups are used as survey trucks and personnel carriers . . . two-tonners are shooting trucks, recording units and drilling trucks . . . the Ford F-800 Heavies carry an HD 1000 combination air-and-water drill.

The Rayflex Exploration Co. of Dallas serves the petroleum industry throughout the United States from Canada to the Gulf, and operates overseas as well. At the present time it has seven crews in the field.

The trucks shown *(above)* are two of the company's Ford F-600's equipped with HD V-8 engine, 4-speed transmission, 2-speed rear axle, special grille guard, winch and non-spin rear axle.

"All our Ford Trucks have proven their durability and operating economy. For example, truck No. 151 (1952 F-100) has 146,436 rugged miles and the engine has never had a complete overhaul—just new rings and a valve job. Last year it operated at a cost of only 4½ cents per mile. Truck R-20C (1956 F-800) has 101,090 miles without major repairs. It has run for 7⅞ cents per mile. These cost figures include all gas, oil, maintenance and repairs.

"We have all Ford Trucks except for our 4 x 4 pickups, and now that Ford builds this type of unit we'll probably be 100% Ford in the future."

Again in '60
FORD TRUCKS
offer Certified Savings!

CERTIFIED FORD TRUCKS 1960 PROOF

CERTIFIED ECONOMY . . .

Yes, this year, if you buy a Ford Truck, you get a truck with certified economy in the three major expense items: gasoline, tires and initial price.

Best Gas Mileage! Results of second running of Economy Showdown U.S.A., show 1960 Ford ½-ton Pickups won every test—beat the average of other four leading makes by 13.1%.

Double Tire Life! Under average conditions, Ford's truck-type suspension gives double the front tire life of that obtained with "soft-type" independent suspension used on some 1960 trucks.

Lowest Prices!* New 1960 Ford ½-tonners are priced from $33 to $181 below those of leading competitive makes. List prices of all Ford Light and Medium Duty models are lowest in their class.

CERTIFIED DURABILITY . . .

The refinements built into the '60 Ford Heavy and Super Duty Trucks for longer life and greater reliability will also bring savings to your operation.

Automatic Radiator Shutters, standard on all Super Duty models, add considerably to engine life. Reduction of coolant temperature variations from a 79° range to a 20° range means less expansion and contraction, more efficient combustion and better lubrication.

Dynamometer Tests of Ford's submerged-type electric fuel pump showed no vapor lock at temperatures up to 200° F. Incipient vapor lock with mechanical fuel pump resulted in a 9% power loss under the same conditions.

Shaker Table Tests plus constant exposure to oil, water and heat proved Ford's 1960 wiring harness to be three times longer lived than the 1959 harness.

CERTIFIED ECONOMY REPORTS . . .

Certified results of these and other tests conducted by America's leading automotive research organization, plus a comparison of manufacturers' suggested list prices, are now available at your Ford Dealer's. Take him up on his offer to check the records . . . see and drive the new Ford Trucks . . . *and you'll save for sure!*

**Based on latest available manufacturers' suggested retail prices, including Federal excise tax, excluding dealer preparation and conditioning and destination charges*

FORD TRUCKS COST LESS

LESS TO OWN . . . LESS TO RUN . . . BUILT TO LAST LONGER, TOO!

For more data on advertised products, use Readers' Service Cards, last page.

How to do it

PIPE LINE HINTS

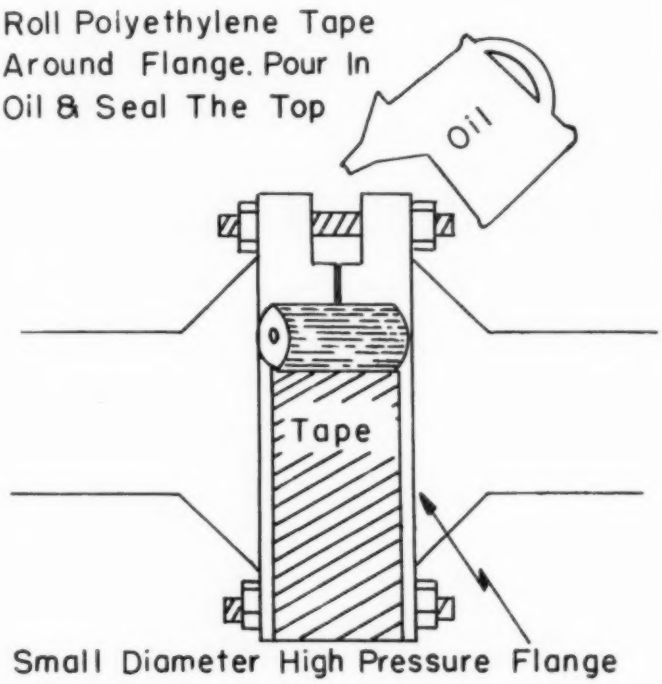
$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas

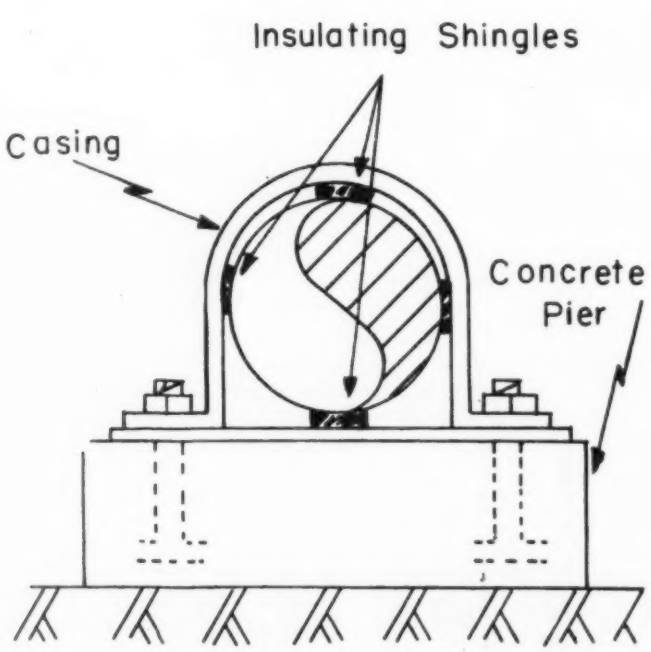
Tape Holds Oil Between Flanges Preventing Corrosion

Some years back, the editors of PIPE LINE INDUSTRY published a hint covering the use of polyethylene tape to prevent corrosion of the highly stressed studs in a flange installation. The tape was used simply to keep out moisture from rain etc.

But, some of our readers have pushed ahead as usual, and we're out 10 bucks—purchasing almost the same idea. The only difference is that space between the flanges is filled with corrosion resistant oil! It is obvious that this will not work where vibration is great, and with the large diameter flanges you would have to use metal strapping to reinforce the adhesiveness of the tape. Because of the static head involved, it probably will not work with large flanges. But, no matter—large flanges have large bolts and corrosion of studs is a minor problem.

On the other hand small, high-pressure flanges carry relatively small studs making corrosion a more serious problem. This is where the oil shines. Try it!





Use Shingles to Insulate Above-Ground Yard Piping

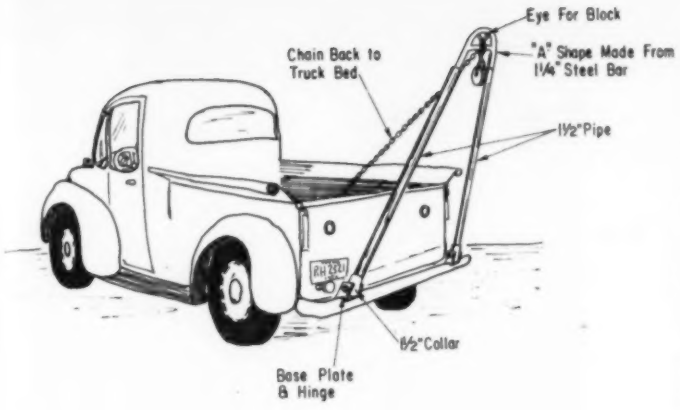
The wonders of simplicity will never cease. Nor will the ingenuity of a pipeliner. A red-headed chief draftsman dreamed up this idea which makes it possible to insulate all yard piping from piers, pipe sleeves, etc., for only a few dollars!

The device is as simple as an ordinary shingle. In fact, it is a shingle—made of fiberglass and plastic—with a wedge-shape and a slight concave-shape on one side. In addition, there is a slight flange at the blunt end.

Here's the way it works. Take a strain on the pipe, slip one of the "shingles" beneath the pipe to separate it from the bearing plate atop the concrete pier. Next, wedge the shingles around the pipe between the pipe clamps and the pipe. Tighten the clamps to hold the insulating shingles in place.

Where the pipe goes through a wall—usually through a metal sleeve or mechanical coupling, the shingles can be used if needed.

This makes it possible to insulate all yard piping from external contact for just a few dollars.



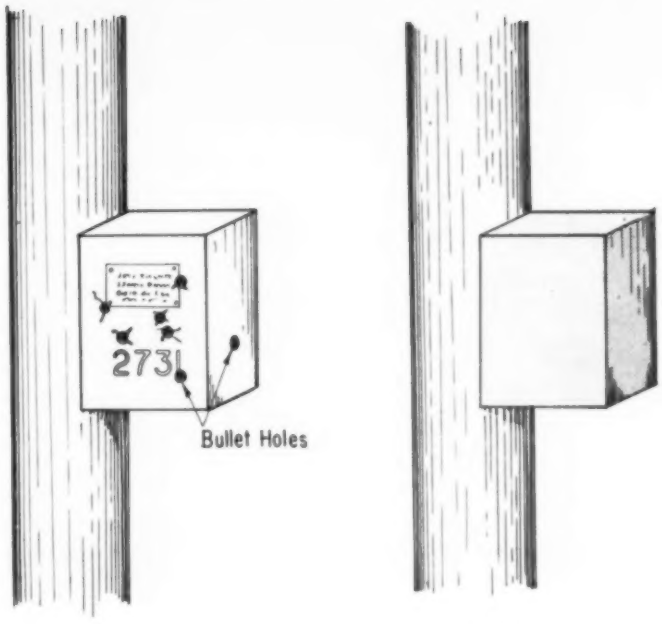
Gin Pole on Pick-Up Truck Simplifies Mechanic's Work

Here's a life saver for a field mechanic. Often he needs to lift heavy engine parts, but lacks the "sky-hook" to attach a block. This simple, light-weight gin-pole arrangement, made of 1½-inch pipe and employing a come-along or coffin hoist as motive power, may prove highly effective on many mechanics' trucks.

To make this gin pole, simply weld two sets of base plates on the back bumper. Bend two pieces of 1½-inch pipe to form an "A", and fabricate a top piece similar to those used on regular gin trucks. Drill the base plates and collars on the 1½-inch pipe as shown. Into the top of the "A" weld an eye to fit the hook on a snatch block, and you are in business.

To lift a load, simply assemble the "A" frame (all of the parts are light and easily carried as regular equipment on the truck) and thread a light wire-rope with a hook on it through the snatch block. Pull on the wire with a come-along to lift the load.

Note that this gin pole arrangement is not meant for heavy loads. Possibly 350 pounds is about the heaviest load that should be lifted. Note that a chain supports the "A" frame from the truck bed. This chain can be used with the hoist to raise loads.



How to Out-Fox the Hunter And Protect Your Rectifier

If someone is shooting at you—be as inconspicuous as possible! This was good advice in war time—it still holds true.

Fortunately, few of us are shot at today. However, field pipe line equipment—exposed to the sights of the hunter's guns—is a different matter. Take cathodic protiction rectifiers for example. Too often the rectifier that fails has a neat hole where a rifle bullet penetrated a bright metallic name plate which was a nice "bulls eye" and became a hunter's target.

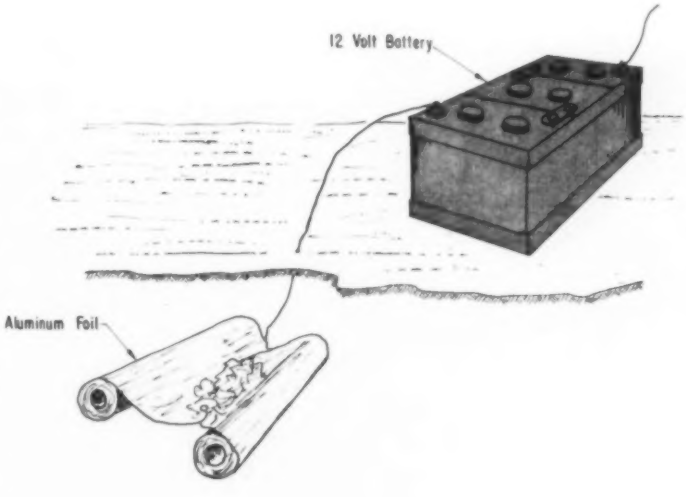
One way to get more mileage out of rectifiers, is to remove all name plates, letters, numbers, etc., from the outside of the cabinets—move them inside. This makes the rectifier a less attractive target, and reduces the chances it will come under "enemy" fire.

Aluminum Foil Serves As Temporary Ground Bed

In making a current requirement test for cathodic protection, the source of power and a temporary ground bed are the big factors.

Where low resistivity soil is encountered and the current requirement is expected to be 10 amps or less, the test can be made with a regular 6-or 12-volt automobile battery serving as the source of power. Regular aluminum foil—the kind your wife uses in the kitchen will serve as temporary ground bed.

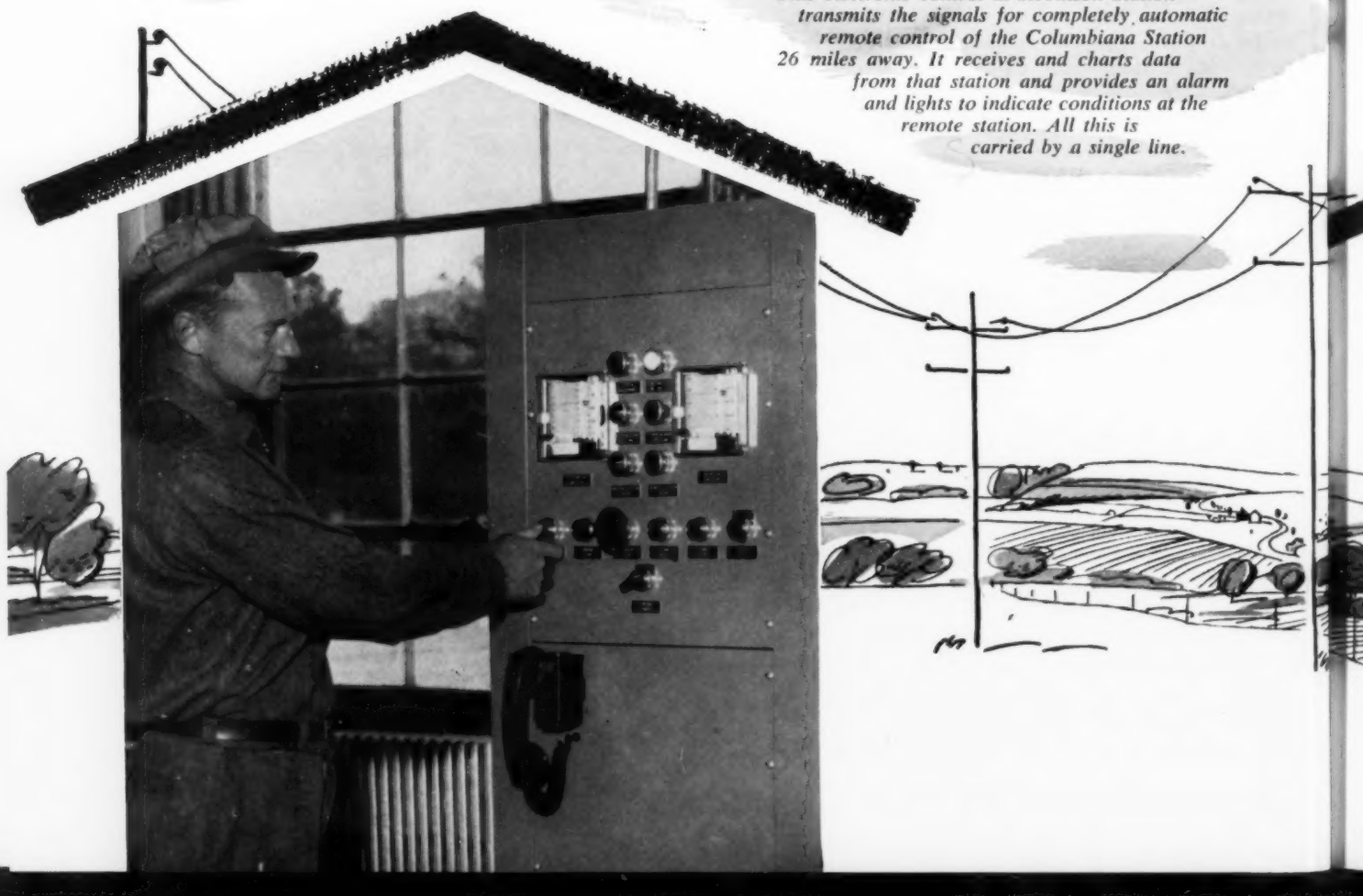
To install the latter, scrape off vegetation down to solid earth; lay out one or more rolls of foil and cover them with earth. To join the rolls, simply twist two strands of aluminum together. If water is available, the output can be increased by sprinkling the ground bed.



Frank Friedli, *Manager,*
En-Tronic Controls Division,
The Cooper-Bessemer Corporation,
explains...

How Cooper-Bessemer En-Tronic® Controls operate compressor station 26 miles away

This electronic control at Robinson Station transmits the signals for completely automatic remote control of the Columbiana Station 26 miles away. It receives and charts data from that station and provides an alarm and lights to indicate conditions at the remote station. All this is carried by a single line.



A part of the gas stored for East Ohio's customers is handled by their Columbiana Station. Here, they have recently replaced a 40-year-old engine-driven compressor with a Cooper-Bessemer GMXD 660 hp Packaged Compressor and En-Tronic Control. This entire installation operates automatically by push-button control from the Robinson Station 26 miles away.

A single telephone line and tone equipment provide a series of frequencies which control all operations... automatic sequencing, system alarms, data reporting, opening and closing of plug valves in the station piping, instantaneous shutting down of compressor in case of failure of power or communications and automatic starting when services are restored, and all other control and regulating functions. The compressor is self-lubricating.

The Cooper-Bessemer equipment makes possible better utilization of skilled operators, greater dependability of control, and a considerable economy in operation.

Why not investigate remote control for your compressor stations... both new and modernized. Call on us for help in evaluating the possibilities.

BRANCH OFFICES: Grove City • New York • Washington • Gloucester Pittsburgh • Chicago • Minneapolis • St. Louis • Kansas City • Tulsa • New Orleans • Shreveport • Houston • Greggton • Dallas • Odessa • Pampa Casper • Seattle • San Francisco • Los Angeles

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C-B Southern, Inc.... Houston

Cooper-Bessemer International Corp.... New York • Caracas • Anaco

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ENGINES: GAS • DIESEL • GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE, TURBINE OR MOTOR DRIVEN

Foreground: Cooper-Bessemer GMXD-10 660 hp Packaged Compressor at Columbiana Station.
Background: Cooper-Bessemer En-Tronic Control which performs all engine and compressor control functions, actuated from the master station.

Rules of Thumb

and Engineering Data Sheets for the Pipeliner's field notebook

$25 for Engineering Data Sheet $15 for Rule of Thumb

These practical aids give quick, reasonably accurate answers to design, maintenance and cost estimating problems. PIPE LINE INDUSTRY will pay $25 for each chart, nomograph or data sheet published—$15 for each Rule of Thumb. Send your ideas to PIPE LINE INDUSTRY, P. O. Box 2608, Houston, Texas

Pipe Line Construction

—21—Strength and Weight of Popular Wire Rope

The following tables give the breaking strength for wire rope of popular construction made of improved plow steel.

SIZE	6 x 19 Breaking Str.	6 x 19 Weight
1/4	5,480	0.10
5/16	8,520	0.16
3/8	12,200	0.23
7/16	16,540	0.31
1/2	21,400	0.40
9/16	27,000	0.51
5/8	33,400	0.63
3/4	47,600	0.90
7/8	64,400	1.23
1	83,600	1.60
1 1/8	105,200	2.03
1 1/4	129,200	2.50
1 3/8	155,400	3.03

Size	6 x 19 Breaking Str.	6 x 19 Weight
1 1/2	184,000	3.60
1 5/8	214,000	4.23
1 3/4	248,000	4.90
1 7/8	282,000	5.63
2	320,000	6.40

Conversion Factors For Wire Rope of Other Construction:

To apply the above table to wire rope of other construction, multiply by the following factors:

Wire Rope Construction	6 x 19	6 x 29	6 x 37	18 x 7
Strength Factors	1.00	0.96	0.95	0.92
Weight Factors	1.00	0.97	0.97	1.08

For example: Find the breaking strength of 6 x 29 improved plow steel wire rope two inches in diameter.

Strength = 320,000 x 0.96 = 307,000 lbs.

The weight can be found the same way.

Miscellaneous

—41—Shrinkage and Expansion of Excavated and Compacted Soil

Ever notice how the spoil from a ditch occupies a greater volume than the ditch itself? There's a reason. **Excavate sand and it expands about 10 percent. Ordinary soil expands about 25 percent and clay expands about 40 percent.**

Here's a summary of the bulk you can expect from excavated soil:

Type soil	Undisturbed	Excavated	Compacted
Sand	1.00	1.11	0.95
Ordinary earth	1.00	1.25	0.90
Clay	1.00	1.43	0.90

Example: Find the volume of loose spoil from a pipe line ditch 42 inches wide, 60 inches deep. The excavation is through clay.

Volume of undisturbed clay soil:

3.5 x 5.0 = 17.5 cu. ft. per lineal foot of ditch.

Volume of the spoil will be 143 percent of the undisturbed volume.

Volume of spoil = 1.43 x 17.5 = 25+ cu. ft. per lineal foot.

Through mechanical compaction this volume can be reduced to 15.75 cu. ft.

WHAT'S HAPPENING
IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, Construction Editor

Southern California Lets Contracts on Gas Pipe Line

Contracts have been awarded by Southern California Gas Company and Southern Counties Gas Company for construction of 115 miles of 36-inch gas line from Newberry to Placentia, California.

The line will tie in with the Pacific Lighting Gas Supply Company line which will receive gas from Transwestern Pipeline Company. Southern California and Southern Counties serve the Los Angeles area.

Young & Anderson Company will lay the 85-mile section from Newberry to Cucamonga. J. P. Neill & Co., Hood Construction Co., and River Construction Company will build the final 30 miles from Fontana to Placentia which will include several urban areas.

Atlantic Seaboard Plans 43-Mile, 20-Inch Line

Atlantic Seaboard Company plans construction of a 43-mile, 20-inch gas pipe line from Seneca, W. Va. to Terra Alta storage project in Preston County. A 5,500 horsepower compressor station at Terra Alta also is included in the $25 million project.

Columbia Gulf Lays Aluminum Line

Columbia Gulf Transmission Company has completed construction on a one-mile long, 6-inch aluminum gas line near Cameron, La. This is a test installation for Columbia Gulf to evaluate performance of aluminum pipe on its gas system. Weights were added to anchor the line in the marshy area. Gas is moving through line at 1,000 psi. Line was hydrostatically tested to 1,250 psi.

Trunkline Seeks Permit to Construct 252 Miles of Main Line Loops in 1960

Trunkline Gas Company has applied to the Federal Power Commission for permission to construct 252 miles of main line loops, about 140 miles of supply laterals, and a compressor station yard piping loop and measurement facilities.

The $45 million expansion program will complete the looping of Trunkline's pipe line between Longville, La. and Tuscola, Ill. The additional loops will increase the system's capacity from 500 MMcf to 710 MMcf of gas daily.

Trunkline is hoping for an early FPC approval in order to construct the loops in November to start increased service in time for the 1960-61 winter season.

Presently the company has under construction its $82 million 1959 expansion program. This includes a 204-mile main line extension to the Indiana-Michigan border.

Pipe Line Contractors Association Officers

At its annual meeting in Los Angeles, the Pipe Line Contractors Association elected officers and directors for 1960. Officers are seated from left to right, E. G. Morrison, Western Pipe Line, Inc., treasurer; James W. Sharman, Sharman, Allen, Gay & Taylor, second vice president; Jack S. Gray, Grayco Constructors, Inc., president; and R. D. Sheehan, Sheehan Pipe Line Construction Co., first vice president. Directors, from left to right, standing, include, M. S. Williams, Panama-Williams Corp.; R. P. Gregory, Houston Contracting Co.; C. S. LeNoir, C. S. LeNoir Construction Co.; J. C. Howe, Engineers Limited Pipeline Co.; John Williams, Williams Bros. Co.; Kenneth A. Owen, Parkhill Trucking Co.; and Aubrey K. Barlow, McVean & Barlow. Not pictured is director, Roger L. Pentzien, Pentzien, Inc.

Northern Illinois Plans 75-Mile, 30-Inch Gas Line

Northern Illinois Gas Company plans to lay a 75-mile, 30-inch gas line from Troy Grove to La Grange, Ill. The $10 million project will link the underground storage facilities at Troy Grove with distribution system at La Grange.

Transco's 36-in. line goes through the marshes and over the ridge

THE JERSEY "MEADOWS" are in the distance, a no-man's land of muck, mosquitoes, and muskrats. Napp-Grecco laid some 8,500 ft of Bethlehem 36-in. pipe there.

LINE-UP CLAMPS READY, another joint is eased into place. The welded joints were X-rayed and hydrostatically tested.

Here's a pipe-laying job that beats 'em all for sheer orneryness.

Under a $1-million award, Napp-Grecco Co., of Newark, N. J., laid three miles of Transco's new, 36-in. looping line through the notorious New Jersey "meadows," then up and over the 300-ft-high rocky ridge bordering the Hudson River.

For six weeks the contractor's men and equipment slogged through the mucky meadows, at one point laying the pipe 16 ft below mean sea level. Then to the other extreme, drilling, blasting, and clawing their way through solid rock—working slopes so steep they had to anchor their backhoes to heavy tractors to prevent runaways.

To complicate things even more, it was necessary to burrow under a number of highways and, passing through city streets, they had to contend with a maze of underground utilities.

Finally, down the other slope they went, to connect up with dual 24-inchers recently laid across the Hudson River.

The pipe was Bethlehem's, widely used along Transco's 1800-mile-plus looping line from the deep South clear up to the streets of Manhattan.

Why not place *your* order for Bethlehem Line Pipe? It's available in any size you need, right up to 42 inches OD. *And with walls to ¾ in. in all the larger diameters through 42 in.*

BETHLEHEM STEEL COMPANY

BETHLEHEM, PA.

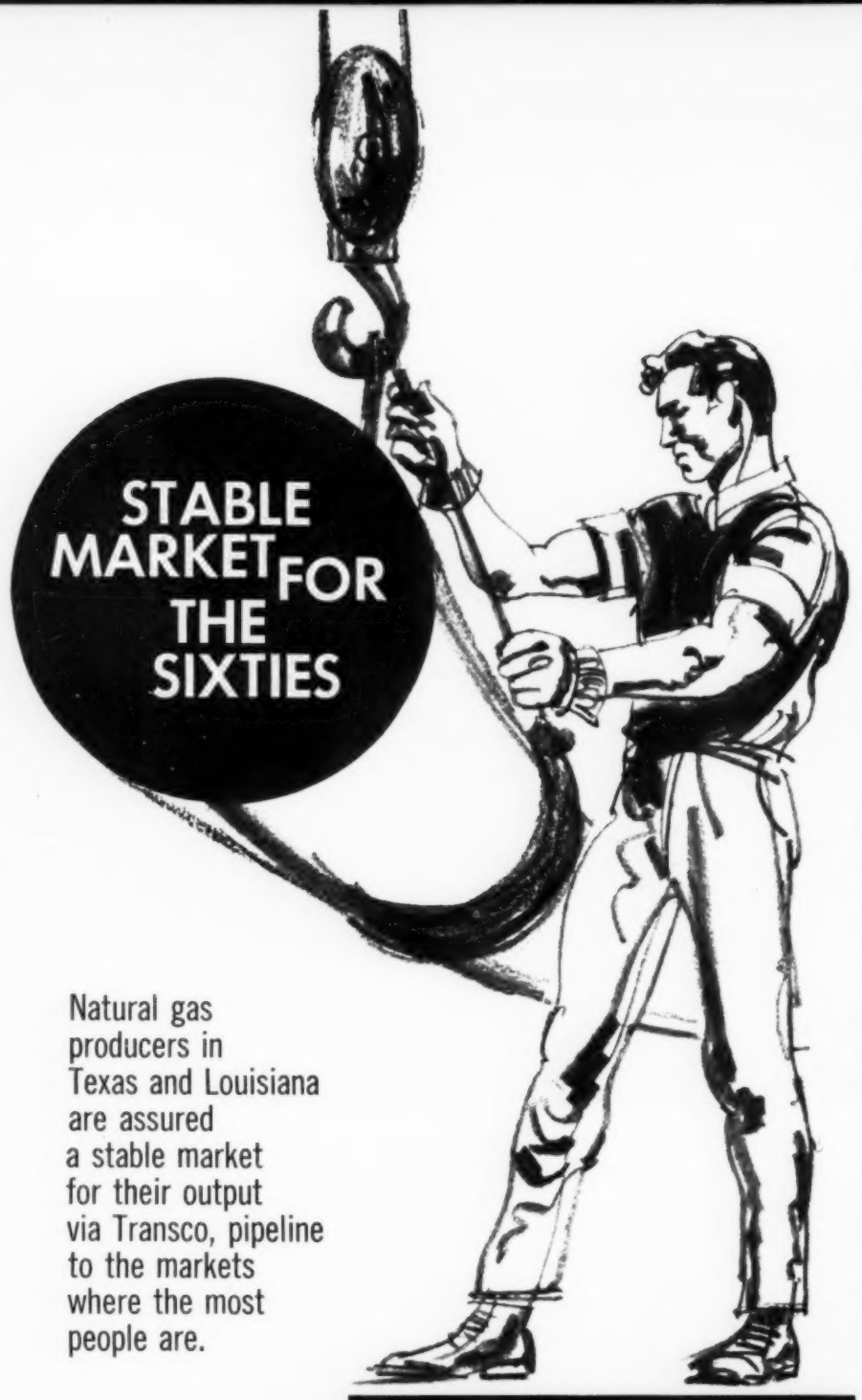
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

ON TOP OF THE RIDGE, in a thickly populated area, the contractor had to thread the joints through a network of sewer, gas, and water pipes. Bethlehem produces expanded pipe with ¾-in. walls in the larger diameters, for use where higher safety factors are required.

BETHLEHEM'S ELECTRIC RESISTANCE-WELD PIPE was used for utility tie-ins all along Transco's main line. It's now available from 5⅝ in. to 16 in. OD in lengths to 60 ft. We also manufacture continuous buttweld pipe up to 4½ in. OD.

BETHLEHEM STEEL



Natural gas producers in Texas and Louisiana are assured a stable market for their output via Transco, pipeline to the markets where the most people are.

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

Cities Service Gas Co. Plans $10 Million Program

Cities Service Gas Company announces a $10 million construction program for 1960. Two new compressor stations, underground gas storage field, and construction of 22 miles of pipe line are planned for the year.

The 3,600 horsepower compressor stations will be installed near Montezuma in Gray County, Kansas and near Stafford, Kansas. The underground storage field is 12 miles southwest of Lyons, Kansas. The company will convert the gas field into a storage facility to be known as the Alden Storage field. It is scheduled for completion in 1961.

Also included in plans is a 13-mile, 16-inch line from Alden Storage field to Lyons station and 10 miles, 16-inch, between Lyons and Hutchison, Kansas.

Other construction plans include an 1,800 hp compressor engine at the company's Alva station in Oklahoma and construction of 9 miles of 16-inch pipe line near Wichita.

Alden storage field will be the company's ninth gas storage field, all located in Kansas. At the field, eight original wells plus four dry holes will be plugged, and 12 new wells will be drilled and equipped for the injection and withdrawal of gas from storage. Average depth of the Misener sand is 3,300 feet.

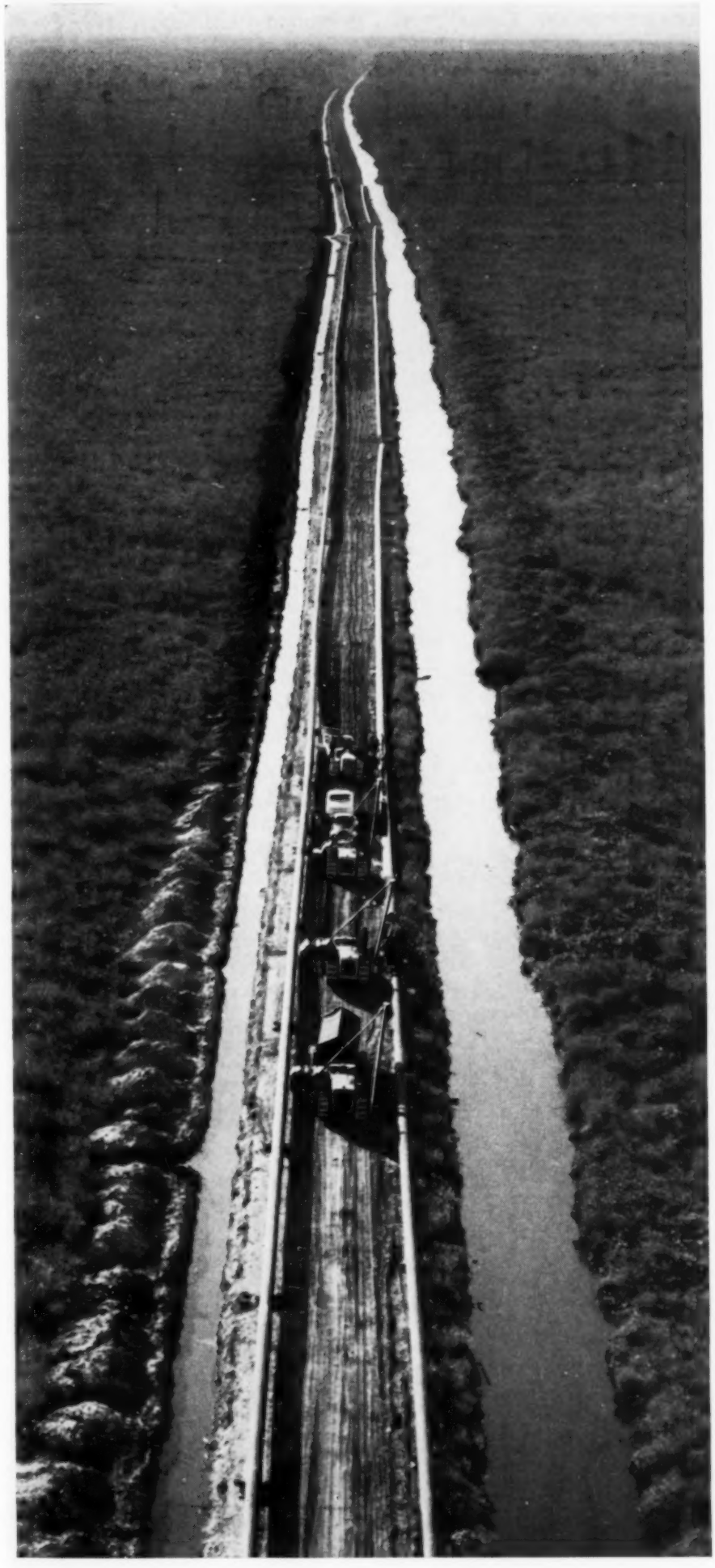
Cities Service has filed with the Federal Power Commission and will begin work on the major projects as soon as approval is received.

Magna Pipeline Co. Receives Approval

Magna Pipeline Company has received approval to lay a pipe line from Vancouver, B.C. to southern tip of Vancouver Island. Magna plans using flexible plastic-steel reinforced pipe, 5-inch diameter at a cost of $14 million.

Island Transmission Company, which proposes to lay a $16 million steel line across the straits, has filed an appeal to the Public Utilities Commission of British Columbia.

Collins Construction Company, consultants for Island, plans 10-inch steel line to be laid on the bottom of the deep straits. In approving the project, PUC stipulated that Magna must have a contract for purchase of flexible pipe by May.



HOW TO CHECK OUT THE TOUGHEST TAPE EVER WRAPPED AROUND PIPELINE

Give it the works . . . that's what Polyken did to its latest development— Extra Strength No. 960

. . . Run it through every tape durability test a laboratory can apply.

. . . Wrap this rugged tape around 30 miles of 24-inch gas line in the swamp water and coral rock of southern Florida. Let an Iranian oil company use it on 200 miles of desert oil line. Put it to work for the Phillips Petroleum Co. in Texas and Canada.

If a tape coating can stand all this and still do the whole job cheaper than hot dope, you've got something special. Something permanent in pipeline protection—Polyken Extra Strength No. 960 Pipeline Roll.

Available at no extra cost.

Applying Polyken protection, as seen above, the Houston Texas Gas and Oil Corporation laid a 1600-mile gas line from Louisiana to Florida. Polyken saved them $500 per mile by way of less men per job and more miles per day. Tape's ready. No primer, no drying or cooling, no fumes or fire hazard. And *low* equipment cost.

Get the full particulars on Polyken performance and economy from your Polyken representative or write Polyken Sales Division, 309 W. Jackson Blvd., Chicago 6, Ill.

Polyken®

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THE KENDALL COMPANY
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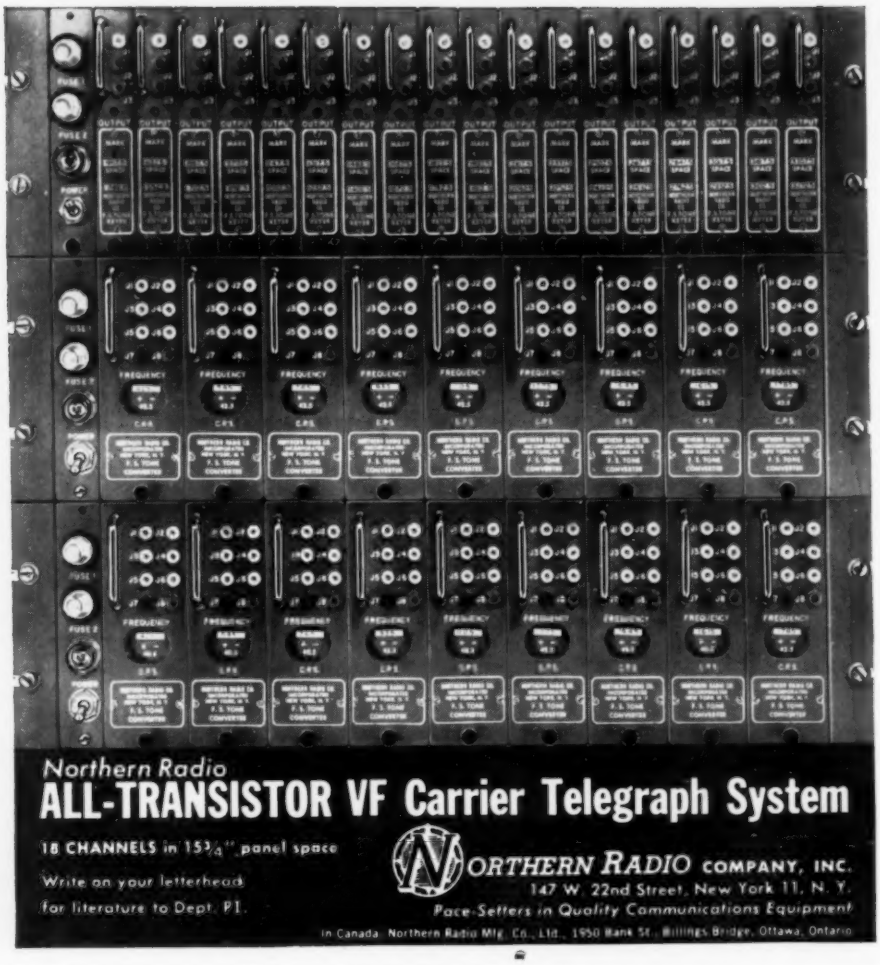
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WmSON "U" SEAL

MAINTAINS TIGHT SEAL
EVEN WHEN DRAG SECTION
CHANGES POSITION IN CASING

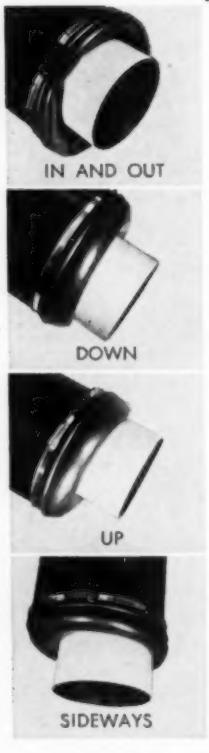
This versatile and flexible "U"-Seal offers NEW ECONOMY in casing seals.

The special demonstrator pictured shows the flexibility of the "U"-Seal. The pipe position changes, but the seal remains tight. A special fungus and bacteria retardent is added to the compound for extra protection. Seals available in sizes 2" and larger.

VERSATILITY OF INSTALLATION

The fully reversible "U"-Seal is easy to install in the new "U" shape or in WmSon's familiar "Z" shape. A screwdriver is the only tool needed to tighten the two stainless steel bands. Send for technical bulletin.

YOU CAN SEAL WITH A "U"-SEAL



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T.D. Williamson, Inc.
P. O. BOX 40 • TULSA 2, OKLAHOMA

REPRESENTATIVES AROUND THE WORLD

French Plan Gas Line From Hassi R'Mel Field

French concerns are planning to build a 24-inch gas pipe line from central Algeria at Hassi R'Mel gas field to the Mediterranean coast. The line will serve coastal cities. Studies are being made to move the gas to the European mainland through a pipe line across the Mediterranean or in liquefied form by tankers.

Contract has been awarded to Groupement Enterpose-Ste. Parisienne pour L'Industrie Electrique on 200 miles of the 320-mile project.

FPC Grants El Paso Temporary Authority

El Paso Natural Gas Company received temporary authorization for construction of 120 miles of 10, 12, 16 and 20-inch gas pipe lines from its existing line at Cowlitz County, Wash. to Eugene, Ore.

The facilities will be used to make deliveries to the Northwest Natural Gas Company of Portland, Ore. The $10 million project consists of 36 miles, 10-inch, 26 miles, 12-inch, 40 miles, 16-inch, and 18 miles of 20-inch.

Peoples Gulf Coast Lets Contracts on Station Work

Peoples Gulf Coast Natural Gas Pipeline Company, formerly Texas Illinois Natural Gas Pipeline, has awarded contracts on compressor station installations. Contractors and station locations include:

Trend Construction Co., Lufkin, and Marshall, Texas, and Texarkana, Ark.; H. B. Zachary Co., Malvern, Searcy and Biggers, Ark.; Dravo Corp., Jackson, Mo. and Hammond, Ill. In each station 2,000 hp units will be added.

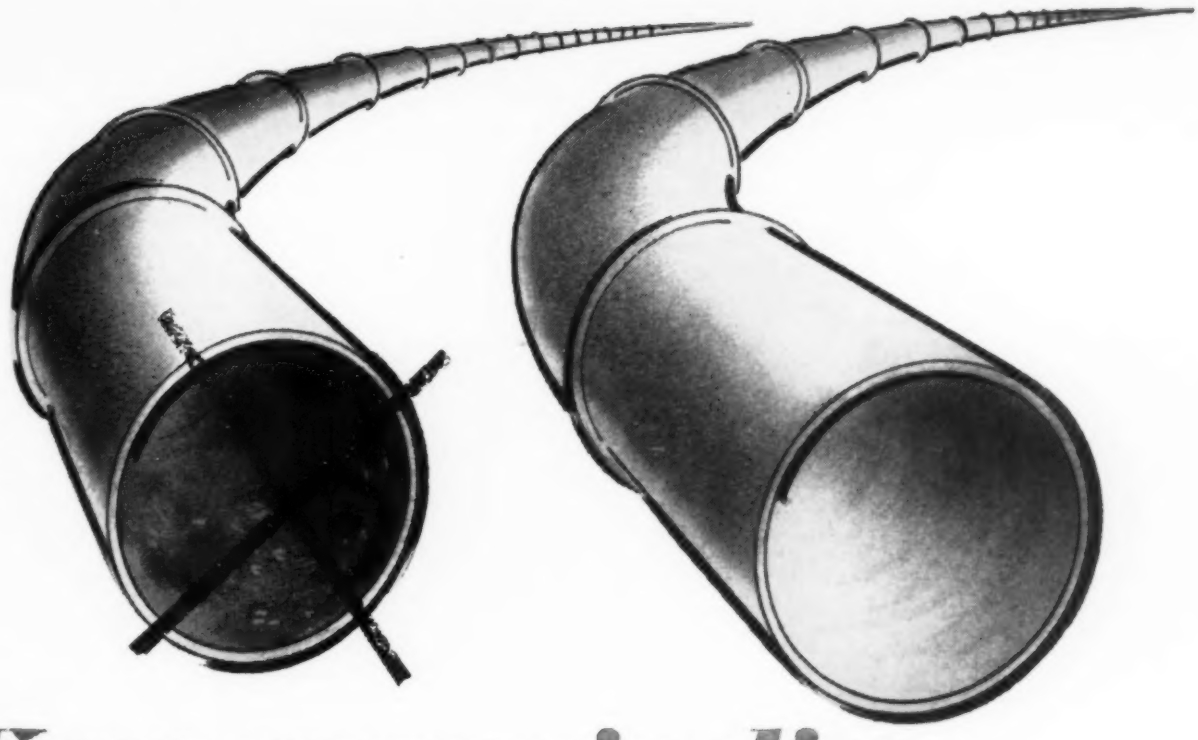
Farmers Union Proposes 200-Mile Products Line

Farmers Union Central Exchange plans to build a 200-mile, 8-inch products pipe line in North Dakota this year. Pipe Line Technologists, Inc. is making engineering studies of the line.

Construction on the line, which will run from Glendive, Mont. to Minot, N. D., is scheduled to begin this spring.

Farmers Union operates a refinery in Laurel, Mont. and has interest in the line extending from Laurel to Glendive.

For more data on advertised products, use Readers' Service Cards, last page.



Keep your pipeline corrosion-free with Solvay Sodium Nitrite

To prevent corrosion right from the start, add Solvay® Sodium Nitrite in low, economical concentration to the products you're moving when you open a *new* pipeline. (Your pipe stays as clean as the cross-section on the right!) You can also use it effectively on older, now-in-service lines—to arrest corrosion and prevent further internal damage.

Solvay Sodium Nitrite forms an invisible gamma oxide film that protects the inner pipe surface from attack by occluded water. It is readily injected by a proportioning-type pump operated by the fluid that is being pumped.

Solvay Sodium Nitrite has several important advantages over other inhibitors. It costs less than most organic compounds. Being soluble in water and insoluble in petroleum products, relatively small amounts are needed. It will not contaminate these products. It will not react with most impurities or organic inhibitors in other petroleum products that may be in the same line.

For more facts and a test sample, mail the coupon now to Solvay.

Sodium Nitrite • Caustic Soda • Calcium Chloride • Chlorine • Chloroform
Caustic Potash • Potassium Carbonate • Sodium Bicarbonate • Soda Ash
Ammonium Chloride • Methyl Chloride • Ammonium Bicarbonate • Vinyl Chloride • Methylene Chloride • Cleaning Compounds • Hydrogen Peroxide
Aluminum Chloride • Mutual® Chromium Chemicals • Snowflake® Crystals
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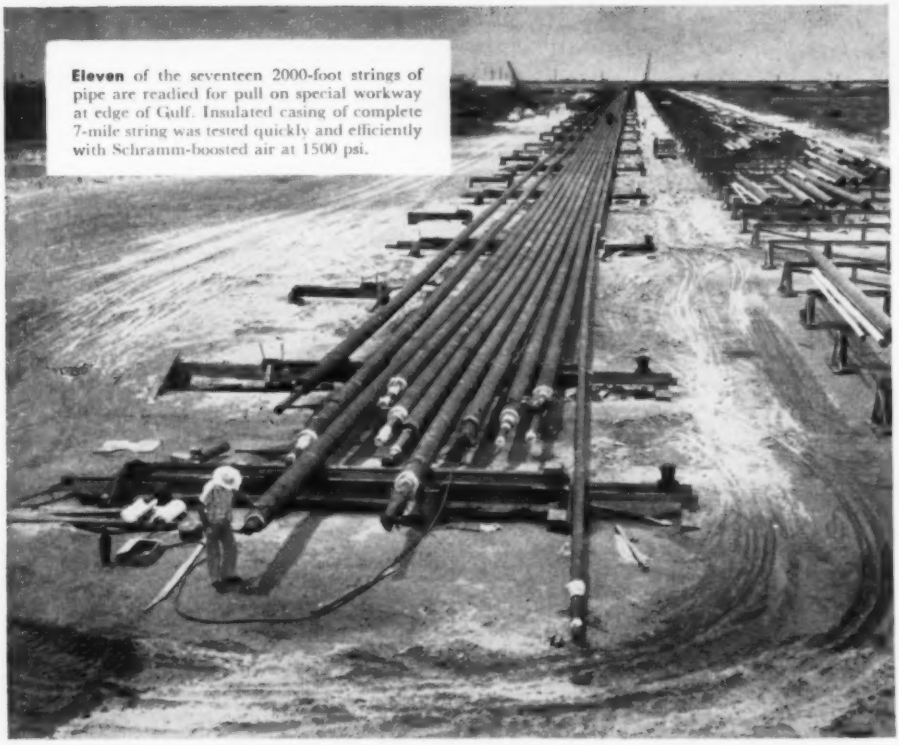

Eleven of the seventeen 2000-foot strings of pipe are readied for pull on special workway at edge of Gulf. Insulated casing of complete 7-mile string was tested quickly and efficiently with Schramm-boosted air at 1500 psi.

SCHRAMM-BOOSTED AIR MAKES PNEUMATIC TESTING PRACTICAL!

Schramm tests Freeport's 7-mile pipe line with compressed air!

Now, from the Freeport Sulphur Company's huge 7-mile under-water pipe line . . . more proof of how fast and easily you can test pipe lines, using compressed air from Schramm equipment. This newsmaking pipe line is a complicated 3-in-1 job: a 6-inch molten sulfur carrier, jacketed by a 7⅝-inch hot water line insulated and rolled into a 14-inch casing. After the line was pulled into place the complete length of the 14-inch casing was tested to 1500 psi in 39 hours with Schramm pipe line testing service. At the start, air was supplied by a Schramm 125 cfm Compressor, for velocity control to protect insulation on the 7⅝-inch pipe. Talk about a "clean" job in your operations! Schramm equipment rolls to your test site on tractor trailers, eliminates problems of water supply and disposal, weather factors, uneven pressures and delays in draining lines. Get details on Schramm savings today!

See the Yellow Pages for local Sales, Service and Rentals of Schramm Air Compressors.

Schramm equipment is easily moved to any location. Lines are ready for use the instant testing is completed.

Buy or rent. Schramm offers a complete package: three Schramm 600 cfm Portable Compressors (*rear units*), two 1-D Booster Units (*center*), and one PPC Booster Unit. Rental includes delivery to site, complete operating team.

Schramm, Inc.

MANUFACTURERS OF AIR COMPRESSORS

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Companies File Budget Applications With FPC

Texas Eastern Transmission Corporation, Arkansas Louisiana Gas Company and Consolidated Gas Utilities Corporation have filed budget-type applications with the Federal Power Commission.

Texas Eastern proposes to build facilities in 1960 not to exceed $4 million; Arkansas Louisiana will build up to $2.5 million; and Consolidated Gas proposes less than $750,000.

Kaneb Pipe Line Company Completes Products Line

Kaneb Pipe Line Company has put into operation its new extension into South Dakota. The company also announced an interchange connection with Great Lakes Pipe Line Company near McCool Junction.

Refined products are moved through Kaneb's 6-inch line connecting Consumers Cooperative Refinery at Phillipsburg, Kansas, into Kaneb's Fairmont terminal near Geneva, Nebraska, as well as the two new northern terminals.

Continental Oil Co. Forms Intrastate Gas Department

Continental Oil Company has established a new intrastate gas and gas products department for operations of intrastate gas systems. J. W. Ferguson, Houston, formerly director of natural gasoline and gas operations, will be general manager of the department.

Lone Star Proposes 40-Mile, 12-Inch Line

Lone Star Gas Company will lay a 40-mile, 12-inch gas pipe line from Eastland to Callahan counties, Texas, early this year.

American Louisiana Granted FPC Authorization

American Louisiana Pipe Line Company has been granted a permanent certificate for construction of facilities to cost $7 million.

The project includes two 12,000 horsepower compressor stations in Ohio and Indiana and the addition of 2,000 hp at two existing stations in Mississippi and Tennessee. American Louisiana also will lay three miles of pipe and a meter station in Cameron, La.

CLEVELAND 190 BACKFILLS MAJESTIC'S 52-MILE SPREAD

MAJESTIC CONTRACTORS used a Cleveland 190 Backfiller to fill their 52-mile 30-inch job from Wheatland, Indiana to the Wabash River for Midwestern Gas Transmission Company. The 190's ability to keep backfilling up close behind lowering-in operations helped to complete the spread on schedule in spite of heavy rains that hit the job frequently. Two Cleveland 320 Trenchers were used to cut trench to 4-foot width, usually sloped to 7-foot width at the top.

The Cleveland 190 Backfiller—with its new improved water-cooled clutch, raised boom hinges, huskier crawler drive components, and many other refinements—does your backfilling faster, cheaper and better. Check with your distributor now for the latest dope on this one-man-operated, continuous-filling machine with *all* speeds in each direction.

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PIPE LINE CATALOG

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The Myoco portable kettle is compactly designed to eliminate over-width permit for highway transportation.

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PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

Anchorage Gas Corp., Houston, 165 miles, 12-inch, gas, Kenai to Anchorage, Alaska, $15 million, planned.

Arkansas Industrial Pipeline Corp., Shreveport, 130 miles, 18-inch, gas, Perla-to-Helena, Ark., $9 million, planned.

Atlantic Seaboard Company, Charleston, W. Va., 43 miles, 20-inch, gas, main, Seneca to Terra Alta, W. Va., $25 million, before FPC.

Carolina Pipeline Co., gas, main line, from near Aiken to Pontiac, S. C., $5 million, approved.

Coastal States Gas Producing Co., Corpus Christi, Texas, 289 miles, 14 and 18-inch main line and gathering system, McAllen to Falfurrias, Tex., area, and Lopena to La Salle County, $12 million, contract let on 200 miles to O. R. Burden Construction Corp.

60 miles, small diameter, gas gathering line, to tie in with system under construction and extend to Pearsall County, Texas, planned.

25 miles, gas, Associated Gas & Oil Co. field to South-Tex Corp., processing plant west of Corpus Christi, Texas, planned.

37 miles, gas gathering in Brown, Eastland, Comanche and Erath counties, Texas, planned.

Coastal Transmission Corp., Houston, 81 miles, 3 to 10-inch, gas, laterals; 5,500 hp in stations at Port Lavaca, Texas, and Eunice, La., and additional 1,500 hp at Robstown, Texas, $6.2 million, before FPC.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, gas, Green River, Wyo.-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado; 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, before FPC.

Colorado Oil & Gas Corp., Denver, 400-miles, gas, from Gubik field to Fairbanks, Alaska, planned.

Columbia Gulf Transmission Co., Houston, 12.8 miles, 6 and 20-inch, gas, loop line in Louisiana, $730,000, authorized.

East Coast Pipeline Co., 90 miles, 12- to 24-inch, products, Linden, N. J. to Suffolk County, N. Y., $25 million, planned.

El Paso Natural Gas Company, El Paso, 244 miles, 30-inch, Permian-San Juan loops, 108 miles, 20-inch, field feeder lines, contract let on 120 miles to R. H. Fulton & Co.

69,240 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, planned.

400 miles, 34-inch, Salt Lake City, Utah, to California border, before FPC.

120 miles, 10-20-inch, gas, Cowlitz, Wash. to Eugene, Ore., $10 million, Temporary FPC Authorization.

Equitable Gas Company, Pittsburgh, Penn., 11.7 miles of storage pipe line and other facilities, $2,091,430, authorized.

12½-miles, 16-inch, paralleling existing system in Harrison and Marion counties, W. Va., authorized.

Farmers Union Central Exchange, St. Paul, Minn., 200 miles, 8-inch, products, Glendive, Mont. to Minot, N.D., planned.

Gillette Pipeline Co., Cheyenne, Wyo., 103 miles, crude, from Dead Horse Creek field to Casper, Wyo., planned.

Goliad Corp., Houston (Joint venture with **Union Oil Co. of Calif.**), 85 miles; LPG, Kaplan, La. to Baton Rouge, extraction plant at Kaplan and fractionation plant at Baton Rouge, $12 million, planned.

Great Northern Railway, St. Paul, 400-600 miles, 12-20 inch, crude, from Williston Basin to St. Paul-Minneapolis and Duluth-Superior areas, considered.

Gulf Resources, New York, 125 miles, gas, gathering system, from Lopena area in Zapata County to a point in La Salle County, Texas, planned.

Hope Natural Gas Co., Clarksburg, W. Va., 45 miles, gas, from West Virginia to Pittsburgh area, planned, 20 miles, 24-inch, gas, in Wertzel and Monongalia counties, W. Va., authorized.

Houston Texas Gas & Oil Corp., St. Petersburg, Fla., 199 miles, 2 to 6-inch, gas, laterals; 20,000 hp in five new stations; $12 million, before FPC.

Humble Oil & Refining Co., Houston, 34 miles, 4-inch, propylene, Baytown to Texas City, Texas, planned.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, FPC authorization.

60 miles from Duluth to Silver Bay, Minn., FPC authorization.

Kansas-Nebraska Natural Gas Co., 15 miles, 12-inch, gas, loops and 4,800 additional hp at new and existing stations, $1.5 million, FPC authorization.

Michigan Wisconsin Pipe Line Co., Detroit, 311 miles, gas, main, Marshfield to Appleton, Wis., authorized.

66 miles, 30-inch, loops, Indiana, Illinois, and Michigan, authorized.

continued on Page 75

ENGINEERED METAL PACKINGS

for Pumps, Engines and Compressors

Selecting the proper metal packing—and packing ring material—assures positive, efficient sealing against gas, air, steam.

Specifying the right material for metal packings can make a big difference in seal effectiveness and packing life.

Garlock offers a wide choice, each designed for specific temperatures and pressures:

GRAPHITIC CAST IRON. Unequaled wear-resistant qualities. Graphite assures continuous lubrication between packing and rod. Recommended against 1500 p.s.i. pressures, 800°F temperatures.

STANDARD HI-LEAD BRONZE. Chosen after years of research, this standard bronze has a yield point of 26,000 lbs./sq. in., a tensile strength of 31,250 lbs./sq. in. Can be used against 10,000 p.s.i. pressures, 800°F temperatures.

HI-LEAD SUPER BRONZE. Possesses a yield point of 14,750 lbs./sq. in., a tensile strength of 25,500 lbs./sq. in. Due to better wear properties, it can be used at pressures to 40,000 p.s.i., temperatures to 800°F.

AMBERITE—PLAIN OR GRAPHITIZED. Tough, strong, high impact strength. Excellent where corrosion and mildly difficult lubricant and wear conditions exist. Apply against 600 p.s.i. pressures, 250°F temperatures. Other grades available to meet various conditions.

BABBITT. Used on soft rods and where corrosion is present, lubrication is limited. Standard Babbitt has tensile strength of 10,000 lbs./sq. in. More expensive type has better wear qualities. Recommended for 5000 p.s.i. pressures, 425°F temperatures.

CARBON. Used where no lubricant is allowed. Generally affords the best wear-strength combination available. 700°F is recommended temperature limit; pressures may vary according to grade of carbon used.

TEFLON.* Far superior to many other rod packing materials because of outstanding chemical resistance, ability to retard wear and friction. Available in carbon- or glass-filled.

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Discuss metal packing materials with your Garlock representative. Call him at the nearest of Garlock's 26 sales offices and warehouses throughout the U. S. and Canada. Or, write for Catalog AD-166. The Garlock Packing Company, Palmyra, N. Y.

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IN THE AIR

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Vinyl outer layer
. . . tough, abrasion resistant
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. . . waterproof

Butyl Rubber inner layer
. . . gasket-like seals
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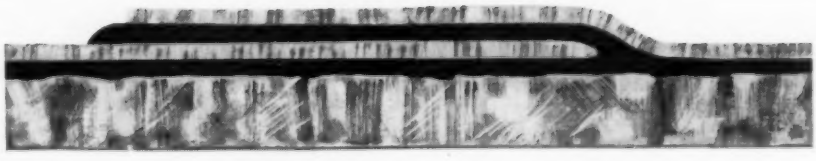
. . . non-conductor
. . . resistant to chemical, fungus and bacteria attack
. . . good bonding
. . . waterproof

Plicoflex primer
. . . superior bond between metal and tape
. . . adheres even under dusty conditions
. . . application unaffected by temperature (weather) extremes
. . . fills in even smallest of surface scratches and pits



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Plicoflex pipe wrapping tape is available in widths up to 54", in thicknesses from 15 mils to 35 mils and in 10 standard colors.

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PROPOSED CONSTRUCTION
continued

342 miles, 24-inch, gas, loops, Kansas, Missouri, Illinois, and Iowa, before FPC.

123 miles, 30-inch, loops, between Sandwich, Ill and Big Rapids, Mich., before FPC.

37 miles, 6 and 12-inch lateral loops in Wisconsin, before FPC.

29 miles, 30-inch, loops, Illinois, Indiana, and Michigan, 3,000 hp. station, Janesville, Wis., before FPC.

Two 2,000 hp units at Meade, Kansas; one 2,000 hp unit at Havensville, Kansas, before FPC.

Midwestern Gas Transmission Co., Houston.

504 miles, 24-inch, gas, from Minnesota-Canada border near Winnipeg to Marshfield, Wis., $52 million, FPC authorization.

Missouri-Kansas-Texas Railroad, 1400 miles 8-12 inch LPG line, Midland, Texas, area to St. Paul-Minneapolis, Minn., and Madison, Wis., $55 million, planned.

Montana-Dakota Utilities Company, Minneapolis, Minn., 15 miles, 6-inch, in Montana, gas 1,540 additional hp, $1 million, before FPC.

Natural Gas Pipeline Company, Chicago. 151 miles, 36-inch, gas, loops, between Ford County, Kansas and Joliet, Ill. and 180 miles, 24-inch, main, from Minneola, Kansas to Kiowa County, Okla., $31 million, before FPC.

Northern Natural Gas Company, Omaha. 171 miles, main line extensions, 66 miles, main loops, 139 miles, branch lines, 6,000 hp additions, to extend system from Minneapolis to Duluth-Superior area, $25.7 million, contracts let on 315 miles to Williams Bros. Co. and R. H. Fulton & Co.

46 miles, main line extensions, 191 miles, loops, 1,767 miles, branch lines, and 45,400 additional hp, in Iowa, Minnesota, South Dakota, Nebraska, Wisconsin and Illinois, $76.7 million, FPC authorization.

37 miles, 30-inch, Bushton compressor station to Otis field, Kansas, 7,000 additional hp at Bushton, and development of underground storage facilities at Otis field, $20 million, before FPC.

Ohio Fuel Gas Co., 59 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $5.1 million, planned.

Pacific Gas & Electric Co., San Francisco, 296 miles, 36-inch, gas, from Malin, Ore., to Antioch, Calif., southern section of line from Canada to California, before California Public Utilities Commission.

10 miles, 20-inch, Pittsburg to Walnut Creek, Calif. planned.

2.7 miles, 16-inch, Marin County, Calif., planned.

4.4 miles, 16-inch, Sonoma County, Calif. planned.

7.5 miles, 16-inch, south of Fresno, Calif. planned.

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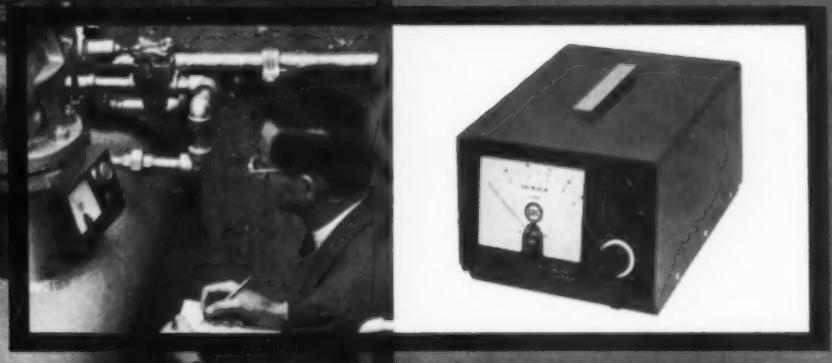
ON STREAM... ON SPEC

CEC Moisture Monitors detect 1 part per million



Plagued with water contamination? CEC's complete line of Moisture Monitors makes possible continuous safeguarding of both gas and liquid streams—instruments accurately and reliably measure trace moisture to less than one part per million water by volume.

PORTABLE MOISTURE MONITORS
are suitable for laboratory or field use. They can be used with or without line power, provide continuous readout on a large front-panel meter. For further information contact your nearby CEC sales and service office, or write for Bulletin CEC 1834-X3.

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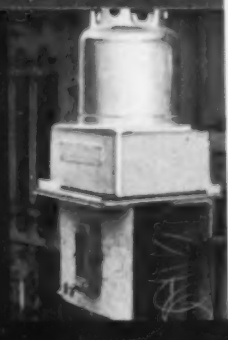
CEC PROCESS MOISTURE MONITORS
for gas and liquids measurements operate unattended—are suitable for closed-loop control. The Analyzer unit can be installed in Class I, Group D, Division 1 hazardous locations. Remote controls regulate instruments from up to 500 feet. Bulletins CEC 1845-X26 and 1856-X6.



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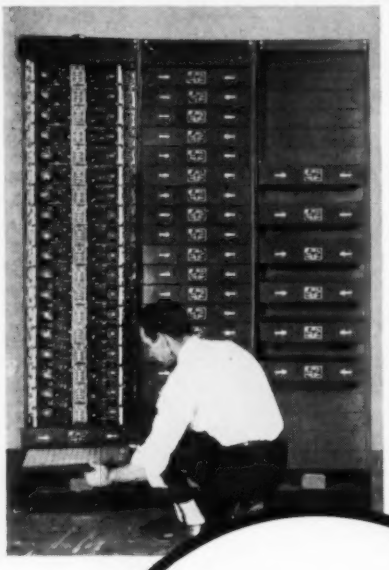

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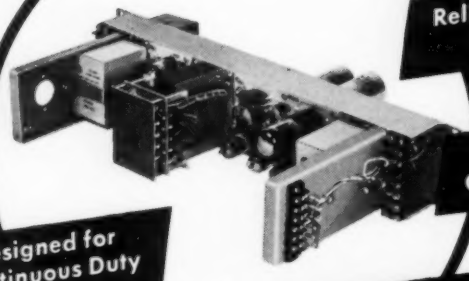

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Operates over any Communication Circuit

Designed for Continuous Duty

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RFL Model 912 Operates over Wire Circuit or Microwave

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The Model 912 Comvor, an audio frequency shift terminal, is used in the transmission of telemeter, telegraph or control signals over either wire line, microwave, or carrier. Up to 90 individual information channels are available in the audio spectrum.

Reliable frequency shift method of keying is used. All essential controls such as transmitter output level and receiver input level are included.

Each terminal contains its own power supply which provides an additional 60 milliamperes at both the transmitter and receiver for the operation of relays, stepping switches, selector magnets, and other components used in telemetering, control and telegraph applications.

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PROPOSED CONSTRUCTION

continued

Pacific Gas Transmission Co., San Francisco, 614 miles, 36-inch, Kingsgate B.C. to Malin, Ore., northern section of Canada to California line, before FPC.

Pacific Northwest Pipeline Division, Salt Lake City, 100 miles gas, gathering lines in San Juan Basin, Garmesa, Piceance Creek, and Big Piney Fields, $3.5 million, planned.

59 miles, 16 and 20-inch, gas, from a point on main line near Camas, Wash., to Salem, Ore., $6.1 million, before FPC.

Peoples Gulf Coast Natural Gas Pipeline Co., Chicago, 16,000 additional hp in stations at Lufkin, Marshall, Texas; Texarkana, Searcy, and Biggers, Ark.; Jackson, Mo. and Hammond, Ill., contracts let to Trend Construction Co., H. B. Zachary Co., and Dravo Corp.

371 miles, 30-inch, loops, and 45 miles, gas laterals, 6,700 hp in Victoria County, Texas, $43.5 million, before FPC.

Permian Basin Pipeline Company, Omaha, 83 miles, 16-inch, gas, from Pioneer's proposed facilities to Spraberry, Texas, and 3,960 hp compressor station, $5 million, FPC examiner approval.

Pioneer Natural Gas Co., Amarillo, Texas, 62 miles, 10-inch main, Pampa, Texas, to Canyon, in Randall County, Texas, 20 miles, small diameter, gathering, 4,000 h.p. stations, $4.5 million, planned.

Phillips Petroleum Co., 25 miles, 6 to 20-inch, gas, South Eunice, New Mexico area, planned.

52 miles, 4 to 20-inch, gas, Gaines County, Texas, planned.

44-mile, 6-inch, products line, from Rocky pump stations to Amarillo, Texas, planned.

Rio Gas Gathering Co., San Antonio, 97 miles, 3 to 8-inch, gas gathering, South Texas, to supply gas to El Paso Natural Gas Company, planned.

Rocky Mountain Natural Gas Company, 65 miles, gas, southwestern Colorado to serve Delta, Orchard City and Montrose, Colo., planned.

Shamrock Oil & Gas Company, 49 miles, 20-inch, gas, Dumas to Amarillo, Texas, planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 200 miles, 34-inch, from Nevada-California border to point near Fullerton, Calif., $44 million, contract let on 115 miles to Young and Anderson Co., J. P. Neill, Hood Construction Co. and River Construction Co.

Standard Oil Company of California, 22 miles, 8-inch, crude, Kenai Peninsula to Nikiski, Alaska, $4 million, considered.

Tennessee Gas Pipeline Co., Houston, 21 miles, 16-inch, 2 miles, 12¾-inch, gas, Louisiana coast, Vermillion, Blocks 46 and 64, $2.9 million, before FPC.

158 miles, 36-inch, looping system in Louisiana and Mississippi, to supply Midwestern additional gas at Portland, Tenn., $61.4 million, authorized.

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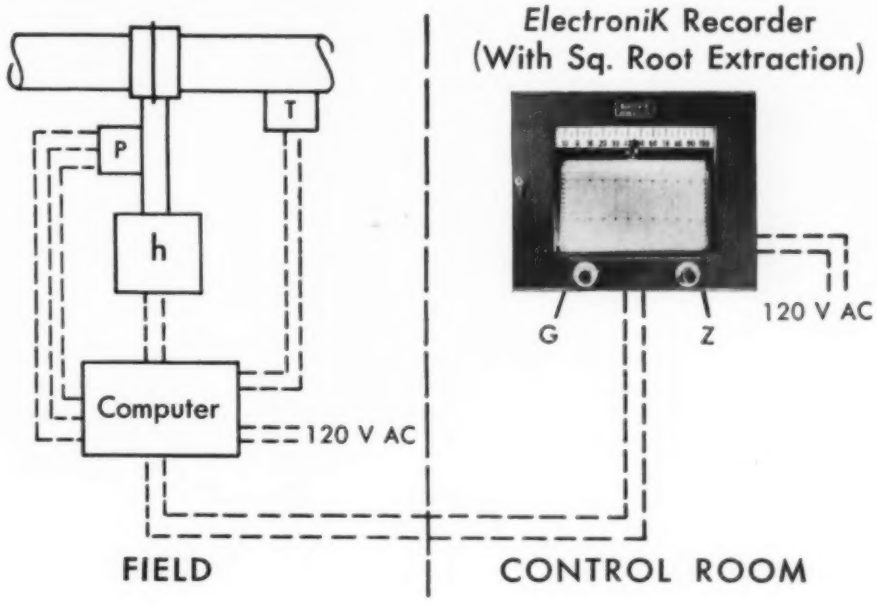

New Honeywell all-electric Gas Flow Computer

measures and records mass flow rate automatically and continuously

Here's how the Honeywell gas flow computer solves a gas flow equation:

$$Q = K\sqrt{\frac{hP}{TGZ}}$$

Where **Q** = mass rate of flow, scfh
h = differential pressure, inches of water
P = static pressure, psia
T = flowing temperature, °R, (°F + 460)
G = specific gravity
Z = super-compressibility
K = orifice flow constant

The *ElectriK Tel-O-Set* △P/I transmitter measures *h*; an absolute pressure transducer measures *P*; and a resistance thermometer bulb measures *T*. The analog computer multiplies *h* by *P* and divides by *T* . . . and sends a resultant millivoltage to the *ElectroniK* recorder. The recorder applies the correction factors G and Z, extracts the square root, and records the resultant mass flow Q.

Easily linked to telemetering and remote control systems, supervisory control, data handling and industrial process computers.

No more tedious, time-consuming calculation of gas flow. This versatile gas flow computer does it for you . . . automatically, continuously. It measures and records gas flow in terms of standard cubic feet per unit time, and is the only all-electric system of its kind.

The Honeywell gas flow computer consists of an *ElectroniK* strip chart or circular chart recorder, a power supply, a standard resistance thermometer, an absolute pressure transducer, a voltage-divider type computing circuit, and an *ElectriK Tel-O-Set* differential pressure-to-current transmitter. The transmitters, transducers and computing circuitry can be mounted *near the orifice*, and only two wires bring the signal into the recorder in the control house. Field-mounted equipment available in explosion-proof housings.

There are many optional accessories. The recorder can be supplied with pneumatic or electric control, retransmitting slidewires, digital encoder, motor or servo-driven control index or pneumatic *Indexet*, hi-lo alarms, auxiliary contacts, pulse telemeter transmitter, and many other options.

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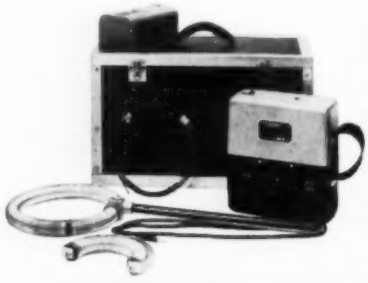
FOUR WAYS TO INSURE GOOD COATING PROTECTION

Continuity is all important in a protective coating. Whether it's a 90 mil coating on a pipeline or a 3 mil coating on a chemical tank, a tiny pinhole can lead to the destruction of the coating. Use of a Tinker and Rasor Holiday Detector will quickly locate pinholes as well as weak spots caused by air bubbles, coke, rust or scale. Minutes spent inspecting with a Tinker and Rasor Holiday Detector while the job is open can save days of down time later on.



Pipeline Detectors

E-P For damp or dry surface, high electrical resistance coatings. Output adjustable from 8000 to 20,000 pulsating voltage. Electrodes available: half circle, spring for pipe to 6", full circle to 30" silicone brush for flat surfaces.

E-4 This lower cost type of detector is specifically designed for smaller diameter pipe and flat surfaces with dry surface, high electrical resistance coatings. Output adjustable from 8000 to 20,000 D.C. voltage.

Thin Film Detector

M-1 For painted or sprayed thin film coatings. Maximum applied voltage 67½ V., non-destructive to coatings. Belt mounted, 4 lbs. total wt.

Underground Pipeline Detector

P-D For detecting holidays, electrical contacts or locating the pipeline itself, **without uncovering the pipeline.** Completely transistorized — long life and light weight.

Engineering Note:

Every protective coating specification should include TR Holiday Detector inspection. Write for specification guide.

DISTRIBUTORS:

Falcon Line Products Corp., Kearny, New Jersey
Crutcher-Rolfs-Cummings, Inc., Houston, Texas
Remco Manufacturing Co. Inc., Tulsa, Oklahoma
Bob Herrick, New Cumberland, Pennsylvania
Canadian Equipment Sales & Service Co. Ltd., Edmonton, Alberta, Canada
Export Agent: Frazar & Hansen Ltd., San Francisco, Calif.

Write today for technical data and bulletin.

Quality Control for Coating Application

TR TINKER & RASOR

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PROPOSED CONSTRUCTION

continued

Texas Eastern Transmission Corp., Shreveport, La.

65 miles, gas, Delmont, Penn., to Lambertville, N. J., before FPC.

40 miles, Lambertvile to Linden, N. J., before FPC.

350 miles, 24-inch, coal slurry, West Virginia to New York, considered.

Texas Electric Service Company, Fort Worth, 300 miles, gas, Old Ocean field to Fort Worth, Texas, $25 million, considered.

Tensas Gas Gathering Corp., Shreveport, 36.6 miles, gas, gathering system in Rodney Field, Jefferson County, Miss. and from North and South Locust Ridge, Lake St. John Field in Tensas and Concordia parishes, La., $855,413, authorized.

Transcontinental Gas Pipe Line Corporation, Houston, 129 miles, 30 and 36-inch loops; 53 miles of laterals, and additional horsepower capacity, in Texas, Louisiana, Alabama, Georgia, North Carolina, Virginia, Pennsylvania and New Jersey, $53 million, FPC examiner approval.

211 miles, 36-inch, and 69 miles, 30-inch, loops and additional 32,040 hp, in Texas, Louisiana, Mississippi, Alabama, Georgia and South Carolina, $52 million, before FPC.

13 miles, 24-inch and 18 miles, 20-inch loops, Louisiana, FPC authorization. 14 miles, 16-inch laterals, 1-mile, 12-inch lateral, Louisiana, $2.1 million, FPC authorization.

29 miles, 20-inch, gas, and 2,500 hp, in South Texas to take gas from South Texas Natural Gas Gathering Co., $2.4 million, before FPC.

Transwestern Pipeline Company, Houston, pipe line facilities to cost $5.4 million to make available additional gas reserves for the line presently under construction, before FPC.

Trunkline Gas Company, Houston, 252 miles, main loops, and 140 miles, laterals, between Longville, La. and Tuscola, Ill., $45 million, before FPC.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., $9 million, approved.

95 miles, 6-8 inch, laterals to Mauch Chunk, Penn., and to Philadelphia, planned.

Valley Gas Transmission, Inc., Houston, 55 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells Counties, Texas, $15 million, before FPC.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. government.

Alaska-Yukon Refiners and Distributors, Ltd., Edmonton, Alta., 150 miles, products, serving Alaska and Yukon territory, $3.5 million, planned.

continued on Page 80

Erase Your Pipeline Protection Problems with this Four-Point PITT CHEM Enamel Program!

COMPLETE QUALITY CONTROL

As a basic producer, Pittsburgh maintains rigid quality control standards at every step of enamel production, from coal to finished coating—your guarantee of consistently superior quality. Today, *Pitt Chem* Pipeline Enamels protect thousands of miles of gas and petroleum product transmission and distribution lines from coast to coast!

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Published to assure you uniform top quality and performance from every drum of *Pitt Chem* Pipeline Enamels—in application and in service.

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Pitt Chem sales representatives are experienced coating men. They talk your language, will help you plan the many requirements of your coating job.

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Pittsburgh maintains a full time staff of field service men to work with your field men in the efficient, economical application of coatings. *Write us about your protection requirements!*

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- PITT CHEM "Tarset"® Coal Tar-Epoxy Resin Coatings
- PITT CHEM "Tarmastic"® Coal Tar Coatings

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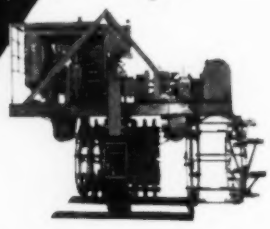
CLEANING and PRIMING MACHINES

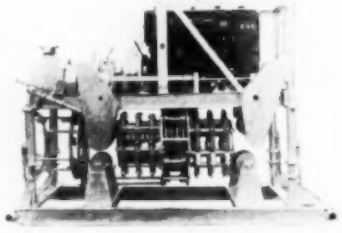


MYOCO MODEL "DR"

Especially designed MYOCO Counter Rotating Heads on this cleaning and priming machine give double cleaning action to pipe.

Seam welds are cleaned thoroughly on both sides.

This fast, dependable unit is powered by an International U-9 self-starting engine using the Ramsey transmission. Engine exhaust is utilized to heat primer tank. Sizes: 3" through 36".



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Set on a stationary base for yard cleaning this 6-12 Model will clean and prime pipe 3" through 14" diameter plain end.

These machines, like all the equipment at Myoco, can be rented to save you capital, investment and storage costs. Trained, courteous personnel are available 24 hours a day with fast transportation to serve you. Efficient equipment operation is assured by periodical checks. All parts and supplies are shipped the same day, when possible.

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In Canada: MYOCO LIMITED, Rural Route 1, Midland Ave. N., Agincourt, Ontario, Canada

Tel. WA 2-9444

PROPOSED CONSTRUCTION

continued

Alberta Gas Trunk Line Company, 386 miles, 26-36-inch, gas, main, Berland River area, Alberta, to Alberta-British Columbia border; and 235 miles, 8-18-inch, gas, gathering, Alberta, $100 million, Alberta Oil and Gas Conservation Board, approved.

Alberta Natural Gas Company (Jointly owned by Westcoast Transmission Co. and Alberta & Southern Gas Co. Ltd.) 110 miles, 36-inch, gas, Alberta border to British Columbia-Idaho border, supply gas to Pacific Gas & Electric Co., $40 million, planned.

Arab League Oil Committee, large diameter crude line from Persian Gulf to Mediterranean Coast, $500 million, considered.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India.

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Creole Petroleum Co., 44 miles, 12-30-inch, gas, Bachaquero to Tia Juana, Venezuela, planned.

Development and Resources Corp., 70 miles, 8 inch, gas, from Agha Jari oil field to Ahwaz, Iran, planned.

Entre Nazionali Idrocarburi, Rome, Italy, crude, from Qum field in Iran to the Mediterranean Sea, considered.

Esso Standard Libya, 100 miles, 30-inch, crude, Zeltan oil field to Gulf of Sirte coast, planned.

Foothills Pipe Line, Ltd., 500 miles, 12 to 16-inch, LPG, from Alberta to Pacific Coast, $80 million, considered.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered.

Additional horsepower in four new stations and several existing stations, $9.3 million, planned.

Island Transmission Company Limited, Nanaimo, B.C., 25 miles, 10-inch, gas, from point near Vancouver, B.C. to Vancouver Island, 67 miles, 10-inch, laterals to Victoria and Nanaimo, B.C., $14 million, appeal before British Columbia Public Utilities Commission.

Magna Pipeline Co., 25 miles, 4-inch, gas, Vancouver, B.C. to Vancouver island, $14 million, approved by Public Utilities Commission over Island Transmission Co. proposal.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

1000 miles, 38 inch, crude, from central Iran to the Turkish Mediterranean coast, considered.

500 miles, 8-inch, products, Teheran to Meshed, Iran, contract let on 250 miles to Williams Bros. Co.

Palestine Economic Corp., New York, 135 miles, 16-inch, crude, Eilat to Beersheba, Israel, to be completed July 1960.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

230 miles, 8-inch, crude gathering, from fields in northeast British Columbia to Dawson Creek, B. C., and

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Ask your Representative about the entirely NEW concept in Cathodic Protection! The Good-All

"AMP-O-MATIC"

Rectifier. Just set it and forget it . . . the Amp-O-Matic automatically ADJUSTS OUTPUT ITSELF!

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PIPE JOINT CLAMP STOPS LEAKS
at joint where pipe is screwed into fitting

SKINNER-SEAL
PIPE JOINT CLAMP stops leaks at joints where pipe is screwed into fitting. Any temperature—any pressure up to 2,000 pounds. Saves the cost of tearing out and renewing leaky fittings. Prevents shutdowns. In stock at most oil supply stores.

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EMERGENCY PIPE CLAMPS for safe, sure, lasting repair of splits and rust holes in pipe. No pressure too high. Anyone can apply in a few moments. Made in all sizes, ½" to 12" for steel and C.I. pipe. Stocked by practically all oil supply stores.

Complete line of Repair Clamps. Send for Catalog 54!

M. B. SKINNER CO.
SOUTH BEND 21, INDIANA

Grande Prairie, Alta., and to existing lines at Sturgeon Lake, $8.5 million, authorized.

Pembina Pipe Line, Ltd., Edmonton, 1,200 miles, LPG, from Alberta gas fields to eastern Canada, planned.

Petroleos Mexicanos, 38 miles, 4-inch products, from Mexico City to Toluca. $500,000 planned.

126 miles, 4, 6 and 8-inch, products, from Mexico City to Cuernavaca and Puebla, $2.5 million, planned.

214 miles, products, Monterrey to Torreon, $6.5 million, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, planned.

Rangeland Pipe Line Company Limited, 111 miles, 8-inch, crude, southeastern Alberta to Calgary, $3 million, planned.

Societa Nazionale Metanodotti, 650 miles, 18-inch, crude, Genoa, to Milan-Cremona-Torino, Italy, and Aigle, Switzerland, with extensions to Karlsruhe and Munich, Germany, planned.

Societe d'Etude du Pipe Line Sud-European, Paris, 419 miles, 30-inch, crude, port of Lavera to Strasbourg, with lateral extending 40 miles to Karlsruhe, Germany, approved by French cabinet.

Standard-Vacuum Oil Company, 60 miles, 8-inch, gas, main, in South Sumatra, considered.

Ste. d-Etudes de Pipeline Intercontinetaux, Paris, 1,400 miles, 30-40-inch, gas, from Hassi R'Mel field in central Algeria across Mediterranean, through Spain, France and into West Germany, considered, Fish International Corporation making engineering and feasibility studies.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Trans-Canada Pipe Lines Limited, Toronto, 50-mile, 30-inch, gas, lateral, Winnipeg to Emerson, Manitoba; 74 miles, 34-inch, loops, additional compressor hp at Swift Current, and Indian Head, Saskatchewan, and Portage la Prairie, Manitoba, $45 million, planned.

268 miles, 34-inch, loops, and additional hp planned for 1961, $69 million.

122 miles, 34-inch, loops, hp additions, $46 million, planned for 1962.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Regina-Moose Jaw areas, $5 million, considered.

Westcoast Transmission Company, Ltd., 250 miles, 30-inch, gas, Taylor to Fort Nelson, B. C., planned.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia to Villa Hayes, Paraguay, considered.

Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina, 621 miles, 12-inch, products, Mendoza to San Lorenzo, Argentina, $19 million, planned.

450 miles, 16-inch, crude, from Neuquen Province to Bahia Blanca, planned.

FREE report tells how to speed up pump-station maintenance

How to speed up maintenance of pumping stations is told in this specially prepared technical service report.

It's full of performance-proved ideas on how to expedite maintenance cleaning operations...how to put a deep cut in maintenance overhead. In it you'll find valuable shortcuts on:

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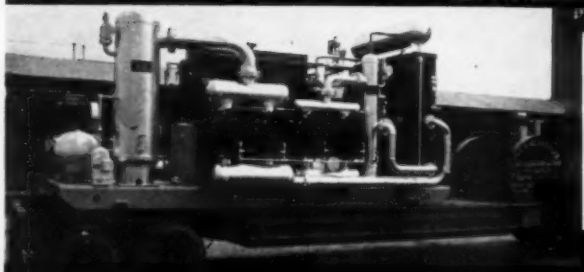

Natural Gas Field station with three 550 hp packaged compressors cooled by Young.

Skid-mounted 440 hp compressor, cooled by Young jacket water cooler, being transported on a truck.

Young "JWC" UNITS COOL POPULAR NEW "ALL-IN-ONE" PACKAGED COMPRESSORS

Prefabricated compressors must be ruggedly built to withstand moving from field to field as needs dictate. Young-built Jacket Water Coolers are engineered to "take it" in the field and on the road . . . are built to last the lifetime of the plant. Heavy formed steel channel side members, steel side supports for cores, press-formed heavy-gauge non-ferrous specially reinforced headers are a few of the outstanding Young features that combine to form a rigid unit capable of withstanding severe vibration and shock. New developments of core structure and arrangements of component parts provide greater low-cost cooling.

Select Young JACKET WATER COOLERS *for*

Engine Jacket Water
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For All Your Cooling Needs

YOUNG RADIATOR COMPANY

General Offices: Racine, Wisconsin

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On the Line

NACE Annual Meeting

Nine pipe line papers will be presented at the National Association of Corrosion Engineers 16th annual meeting in Dallas, March 14-18. Titles and authors for pipe line symposium papers include:

Protection of New Gas Lines Bringing Natural Gas to Florida, by Joseph S. Frink, Houston Corp.; Soil Bacteria in Relation to Cathodic Protection, by J. O. Harris, Kansas State University; Report on Progress of NACE Technical Group Committee T-2, Task Group on Minimum Requirements for Protection of Buried Steel Pipe Lines, by W. H. Stewart, Sun Pipe Line Co.; Corrosion Takes Toll on 24-Year-Old Transmission Main, by John Van Bladeren, Northwest Natural Gas Co.; and Resistance of Aluminum Alloys to Underground Corrosion, by D. O. Sprowls and M. E. Carlisle, Jr., of Aluminum Company of America.

Papers of pipe line interest in the Cathodic Protection symposium are: Packaged Cathodic Protection of the 1,600-Mile Tape Coated Pipe Line to Florida, by E. P. Doremus and R. B. Pass, Cathodic Protection Service; Use of Impressed Current Anodes in Cathodic Protection of Pipe Lines, by W. P. Noser, Humble Pipe Line Company; and Cathodic Protection in Desert Soils, by W. C. R. Whalley, Iraq Petroleum Co.

More than 100 technical papers on a variety of corrosion subjects will be presented at the conference. In addition to hearing technical papers corrosion engineers will meet in about 60 technical committees to exchange information and to hear reports.

NACE Elects Officers

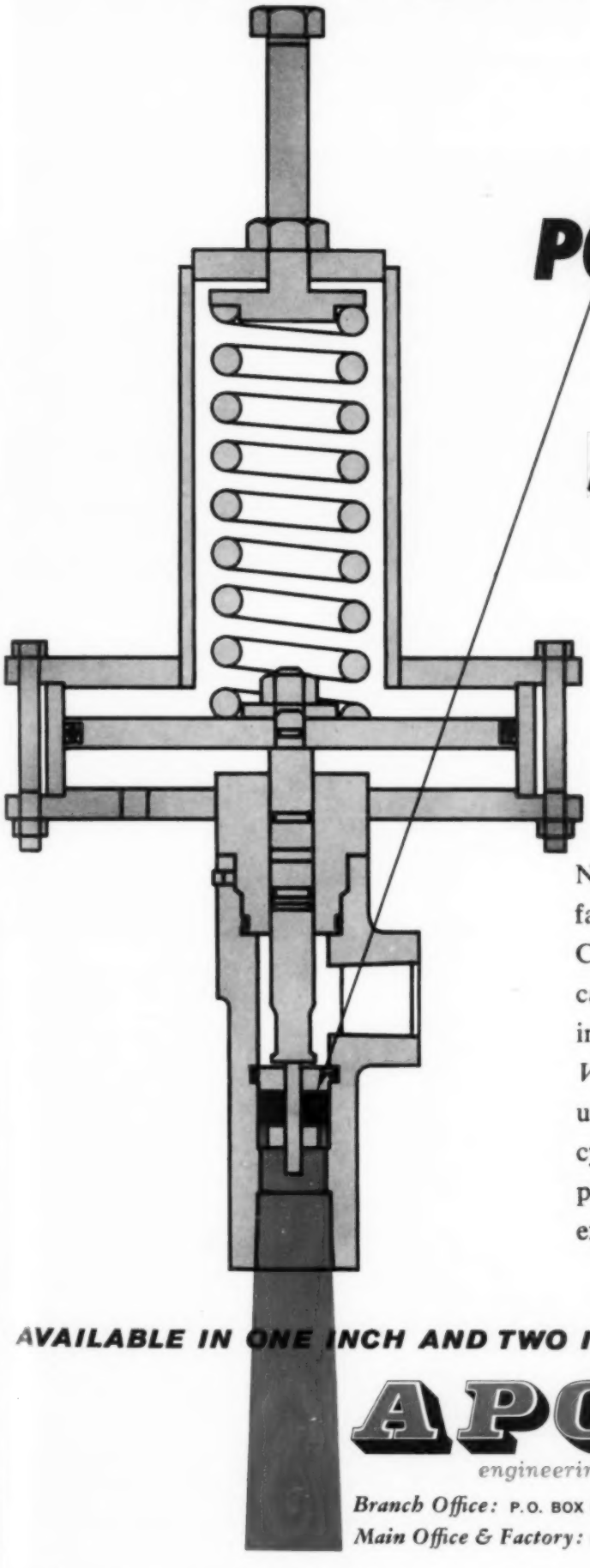
National Association of Corrosion Engineers has elected George E. Best, president for period from March 1960-1961. Best is with Manufacturing Chemists' Association, Washington, D. C.

Edward C. Greco, senior research chemist of the research department, United Gas Corp., is vice president and C. G. Gribble, Jr., district manager for Metal Goods Corp. becomes treasurer.

Three directors elected include J. S. Dorsey, Southern California Gas Co., and J. E. Rench, Napko Corp., and T. J. Maitland, American Telephone and Telegraph Co.

For more data on advertised products, use Readers' Service Cards, last page.

Here's a liquid dump valve with . . .



POSITIVE SHUT OFF *that* STOPS LEAKAGE

The Check-Stream DUMP VALVE

Now you can stop leakage, the major cause of failure in conventional dump valves, with the new Check-Stream Dump Valve. Even the smallest leak can cause an erosive action that can ruin your valve in a very short time. *The Check-Stream Dump Valve gives positive shut off* . . . it will not leak even under the most severe conditions. A solid rubber cylinder, expanded against the body liner by a piston motor, provides positive shut off as well as extremely fine throttling action.

AVAILABLE IN ONE INCH AND TWO INCH SIZES

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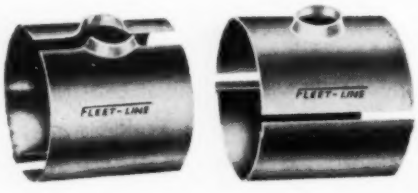
REDUCERS: Concentric and eccentric. Nominal pipe sizes 1" to 30", ASA B16.9, ASTM A234. Schedules 10 to 160, stainless steel, and other alloys. Special lengths and sizes.

SADDLES: Conventional, and for pressure vessel heads. Nozzle sizes from ¼" to 24". Fleet-Line saddles weld neatly into place in much less time, and with much less welding rod.

Full encirclement saddles.



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What's Happening

among MEN in the INDUSTRY

A Century of Service at Service

When Howard F. Wilson, Jr., and Rex C. Bowman received 20-year pins last month it marked 100 years of service that these two families have given Service Pipe Line Company. From left to right, Service employes include Howard F. Wilson, Sr., Howard F. Wilson, Jr., Rex C. Bowman and father James E. Bowman and Arlie I. Zumwalt, who presented the 20-year pins. Wilson Sr., retired in 1956, after 33 years with the pipeline company. James E. Bowman, who joined Service in 1933, Howard F. Wilson Jr., and Rex C. Bowman still work in Service's Tulsa shops under Zumwalt's supervision.

E. J. Gallagher has been elected president and a director of **Peace River Oil Pipe Line Company Limited.** He succeeds **E. D. Loughney** who assumed presidency of **British American Oil Company.** Gallagher is general manager of British American's Production and Pipe Line Department.

E. J. Gallagher

T. W. G. Thomson, vice president of **Texaco Exploration Company** was named treasurer of Peace River, replacing **E. C. Babson** who recently moved to the United States.

Gallagher came to Canada in 1952 as manager of production for Canadian Gulf Oil Company. When that firm was acquired by British-American in 1956, he became assistant general manager of pipe line and production operations. He was made general manager in 1958.

Shell Pipe Line Corporation announces three personnel changes. **J. A. Scheineman,** division engineer in West Texas Division will be transferred to Head Office Technical Services Department. **N. G. Wilson,** engineer in Texas-Gulf Division, succeeds Scheineman. **G. C. Lilley,** engineer Texas-Gulf Division succeeds Wilson.

Scheineman joined the company in 1947 as a junior engineer in the head office. Wilson came to Shell in 1951 as junior engineer in head office, and Lilley became junior engineer in Mid-Continent Division in 1951.

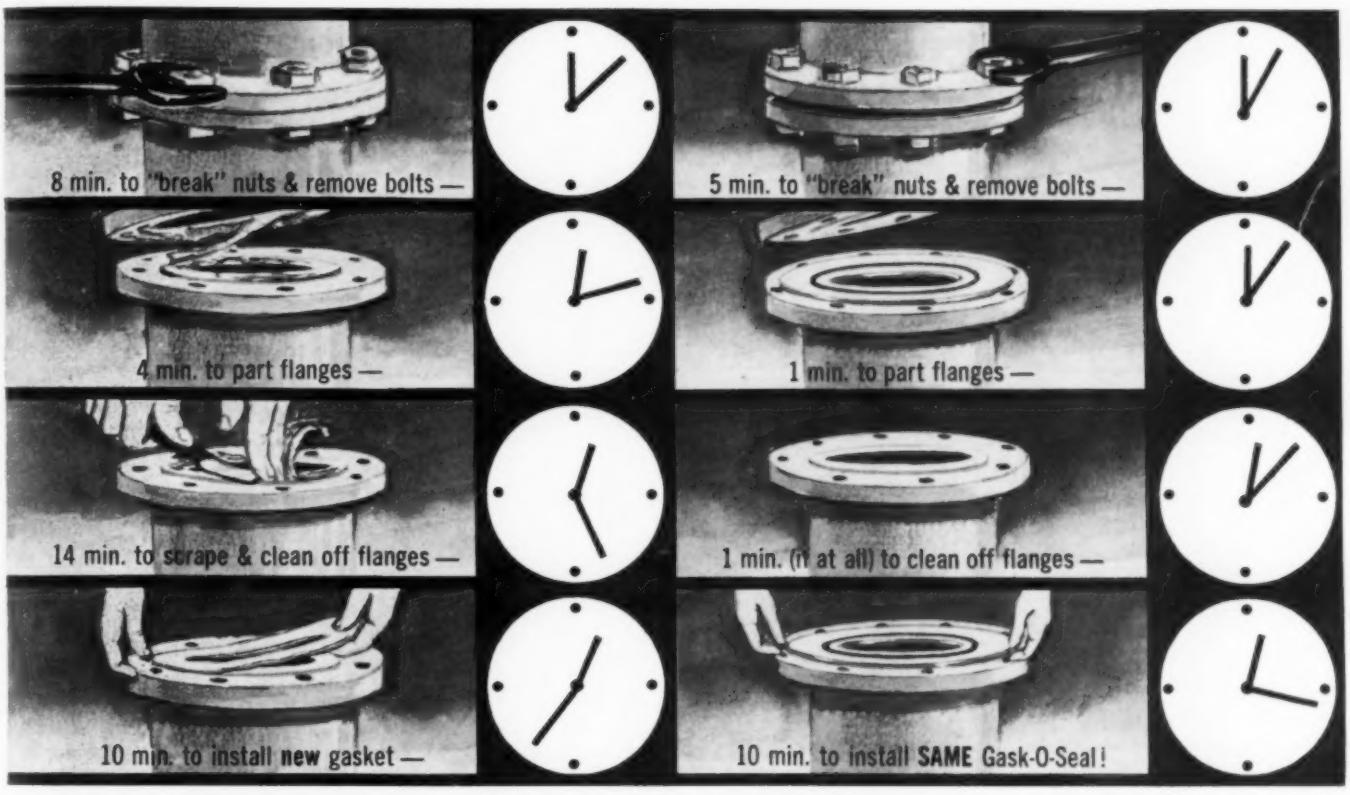
Magnolia Pipe Line Company announces several personnel appointments. **J. E. McGeath** has been made manager of operations; he had been assistant manager of the company. Formerly manager of mechanical and civil engineering, **S. L. Westlake** becomes manager of pipe line development. **C. M. Brecheisen,** who had been manager of Eastern Pipe Lines Division, was named manager of engineering.

M. R. Anderson, formerly manager of personnel and policy, is now manager of employe relations. Formerly assistant manager of personnel and policy, **T. E. Christopher** becomes employe relations advisor. **P. E. Edwards** was named supervisor of safety and training. He had been safety supervisor for Eastern Pipe Lines Division. **Donald R. Jeschke** is the new supervisor of wage and salary administration. He had been employe relations assistant at East St. Louis, Ill., refinery.

Harold C. Price, Jr., has been named president of **H. C. Price Company. Robert K. Shivel** was elected a vice president. Price was named vice president in charge of pipe line division in 1958.

HOW TO SAVE *19 MINUTES* EVERY TIME YOU REPLACE A GASKET!

WITH ORDINARY GASKET | **WITH GASK-O-SEAL**


8 min. to "break" nuts & remove bolts —
4 min. to part flanges —
14 min. to scrape & clean off flanges —
10 min. to install new gasket —
5 min. to "break" nuts & remove bolts —
1 min. to part flanges —
1 min. (if at all) to clean off flanges —
10 min. to install SAME Gask-O-Seal!

TOTAL TIME 36 MINUTES | **TOTAL TIME 17 MINUTES**

Fourteen major industrial plants report that it takes an **average** of 36 minutes to replace an ordinary gasket in standard ASA flanges . . . **with Gask-O-Seals it takes less than 17 minutes!**

There is no scraping or time consuming cleaning of flange faces necessary when you use Gask-O-Seals; no damaged flanges to be re-surfaced or replaced. And, Gask-O-Seal offers many other cost reducing features:

- They will not "blow-out".
- No retorquing of bolts is necessary.
- Vibration or pulse does not effect seal.
- They provide an opportunity to up-grade flanges — to reduce weight, bulk, bolt sizes and numbers . . . plus many more features.

Why not find out how Gask-O-Seals can save **you** time and effort. We'll be glad to send you complete information.

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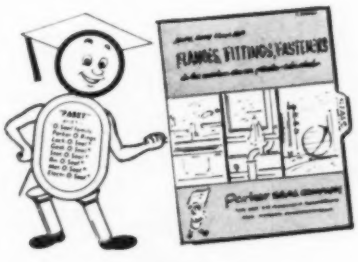

Parker SEAL COMPANY
Culver City, California and Cleveland, Ohio
A DIVISION OF PARKER-HANNIFIN CORPORATION

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NEW CORR-PREV PIPE COATING TEAM SHORTENS YOUR SPREAD

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— *polyethylene* protective tapecoating is ready to wrap, right from the roll. No heating or drying time. Extra-heavy adhesive mass is a *built-in* primer . . . assures fast, permanent tape-to-metal bond.

Chasewrap*

— *abrasion-resistant* overwrap provides a tough, wrinkle-free shield against backfill and soil stress. Wraps simultaneously with tape. Superior to rag or felt overwraps, yet *lower* in cost.

*Trade name of Chase & Sons, Inc., long-famous for protective and insulating tapes for electrical wire and cable.

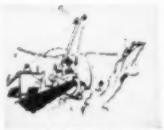
Put the squeeze on your pipe wrapping costs! Start by cutting your present hot-coat labor crews *in half*. Forget about heavy investment in applicating equipment. Get more footage a day *without* material waste and clean-up problems. How? It's simple. With the new CORR-PREV Pipe Coating Team, you have everything you need — *including* high-speed machinery — for faster, easier, more economical pipe wrapping . . . plus unequalled pipe protection against underground moisture, galvanic and chemical corrosion.

The New CORR-PREV Pipe Coating Team

Try this new pipe coating *team* on your next job. From trenching to backfilling, CORR-PREV helps you shorten your spread . . . gives you a pipe coating that's *factory-uniform* in quality and thickness. Most important, you get today's *proven* polyethylene pipe protection at the *lowest applied cost!* Write for sample rolls, specifications and prices. **CHASE & SONS, INC., 26 Spruce Street, North Quincy, Mass.**

Refineries & Gathering Systems

Public Building Lines



Oil & Gas Transmission Lines

CORR-PREV DIVISION

Highway and Airport Conduit & Pipe

Utility Distribution Systems

Chemical & Industrial Plant Piping

Jack S. Gray was elected president of the **Pipe Line Contractors Association** for 1960. Gray is president of **Grayco Constructors, Inc.,** and was a director of the association last year. **R. D. Sheehan, Sheehan Pipe Line Construction Co.,** was re-elected first vice president. **James W. Sharman, Sharman, Allen, Gay & Taylor,** Inc., was named second vice president. **E. G. Morrison** of **Western Pipe Line,** Inc., was elected treasurer.

New directors chosen at the association's twelfth annual meeting in Los Angeles January 31-February 3, include **Aubrey K. Barlow, McVean & Barlow, Inc.; James C. Howe, Engineers Limited Pipeline Co.; C. S. LeNoir, C. S. LeNoir Construction Company; Kenneth A. Owen, Parkhill Truck Company** and **Roger L. Pentzien, Pentzien, Inc.**

Directors who are serving their second year of a two-year term are **John H. Williams, Williams Brother Co.** and retiring PLCA president; **R. P. Gregory, Houston Contracting Company,** and **M. S. Williams, Panama Williams Corporation,** who served as vice president in 1959.

After 41 years service with **Sinclair Pipe Line Company, A. M. Stafford,** vice president and director, retired February 1. He joined Sinclair in 1919 and has held various accounting, supervisory and executive positions.

A. M. Stafford

He has served as assistant to the vice president in charge of pipe lines and production for **Sinclair Oil Corporation** and later New York representative of Sinclair's Pipe Line Department. Presently he is vice president, stockholder and corporate affairs, Sinclair Pipe Line Company.

A. E. Helm has retired from active participation in the pipe line construction industry. His interests in **Fulton Banister Ltd., Banister Helm Ltd.,** and **Banister Construction Ltd.,** have been disposed of to **R. K. Banister.** He will continue with the companies on a consulting basis.

J. F. Pritchard & Co. announces appointment of **A. Russell Young** as assistant executive vice president and general manager. He has been with the Pritchard firm since 1938 and became manager of the gas division in 1944. In 1954 he was named vice president in charge of the gas division. He is engaged in the development of a gas liquefaction plant building program that is producing a liquid methane fuel.

Texas Gas Transmission Corporation has appointed **Jack D. Sullivan** manager of Income Tax Department. He will be responsible for the preparation, filing and payment of all taxes, other than ad valorem taxes, for which Texas Gas is liable. Prior to joining Texas Gas, Sullivan was comptroller for Boring and Tunneling Company of America, Inc. Previously he had been with Transcontinental Gas Pipe Line Corporation and Trunkline Gas Company.

Robert D. Joyce has been appointed superintendent of the Work Order Department of **Natural Gas Pipeline Company of America. Fred L. Scott** replaces him as administrative assistant to **M. V. Burlingame,** executive vice president. Scott had been resident engineer at **Natural Gas Storage Co. of Illinois.**

Joe F. Moss has been named district exploration manager of the **Southwest Gas Producing Company's** South Louisiana district.

El Paso Natural Gas Products Company announces the promotion of **Wayne Elledge** to chief project and mechanical engineer for the company's entire system.

Elledge had been plant engineer at the Ciniza, N. M., refinery. **George Harrison,** chief inspector for the company, succeeds Elledge.

E. W. Christian, vice president and general manager of **The Imperial Pipe Line Company,** has been elected president of the **Pipe Liners Club of Western Canada.** Christian replaces **G. J. Evans** who has moved to eastern Canada. The present enrollment of the pipeliners from Manitoba, Saskatchewan, Alberta, and British Columbia totals 104.

E. W. Christian

Christian had extensive experience in refinery operations in Eastern Canada and South America. He came to Edmonton in 1948.

GET MORE SPEED
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VERTICAL PIPE BENDER

- Fastest bending machine on any spread. C-R-C's reversing clutch gives equal speeds forward and reverse.
- No flattening or egging of pipe. For smooth, wrinkle-free bends on the strongest pipe made . . . the C-R-C Bender is your best buy.
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In Canada: Canadian Equipment Sales & Service Co., Ltd., 7310 99th St., Edmonton, Alberta, Canada

For more data on advertised products, use Readers' Service Cards, last page.

Harry K. Phipps of **Magnolia Pipe Line Company** will retire April 30, 1960.

He had been manager of **Mobil Oil Company's** Central Pipe Lines Division which recently was merged into Magnolia Pipe Line Company. Presently he is on a special assignment for the company. Phipps joined **White Eagle Oil and Refining Company**, which became a part of Mobil, in 1921. His pipe line career started in 1929 and he was named vice president of White Eagle Pipe Line Company in 1939. Since 1953 he has served as manager of the Central Pipe Lines Division.

Harry K. Phipps

John H. Keyes, Jr., has been named manager of **Bayou Pipe Line** system which **Service Pipe Line Company** became operator starting January 1. The 300-mile products system has been operated by **Shell Pipe Line Corporation** since 1942. Keyes supervised construction and operation of several parts of Service Pipe Line Company's 15,000-mile pipe line system. He had been superintendent of the Casper, Wyo., district.

Pacific Gas & Electric Company announces the appointment of **M. H. Chandler** as manager of the Gas Construction Department. He will succeed **Joseph A. Love** who is retiring.

Love has been with the company since 1912. Chandler joined the company in 1940; presently he is senior gas construction engineer.

Northern Natural Gas Company announces the appointment of **James J. McMahon** as senior reserves engineer. He previously had been associated with Shell Oil Company for over 10 years. With Shell he represented the company while working on the Seeligson Unitization at Corpus Christi, Texas, for four years.

J. J. McMahon

At Northern he will be involved in work dealing with gas reserves and availability.

Ross Madole has been named general attorney for the **Magnolia Pipe Line Company.** He will be concerned with all legal matters involving the pipe line company. He had been assistant general attorney with **Magnolia Petroleum Company. Mobil Oil Company** will form a law staff in Dallas to service Magnolia Pipe Line, Mobil Refinery at Beaumont, Texas, Mobil's Southwest Marketing Division, Dallas, and the Producing Divisions in Houston, Midland, Texas, and Denver. Charles B. Wallace, associate general counsel for Mobil Oil Company, will be in charge of the staff.

Charles J. Dunne, assistant treasurer of **Long Island Lighting Co.,** has been named assistant treasurer of the **American Gas Association.** Dunne has been with Long Island Lighting since 1925 and was named to his present position in 1954.

Paul F. Stolpman, purchasing agent for **Pacific Northwest Pipeline Corporation,** was elected national president of the U.S. Submarine Veterans of World War II at the organization's 1959 convention in Denver. He served on the submarine Pompon as a torpedoman for 25 months during the war.

Sun Pipe Line Company announces appointment of **Theodore H. Gunst** as administrative assistant to **W. C. Kinsolving,** president. Gunst joined **Sun Oil Company** in 1938 and was transferred to Sun Pipe Line Company in 1946. He has been personal secretary to the president since 1946.

R. J. Forrest, general superintendent, **Oklahoma Mississippi River Products Line,** has been named vice president, a director and general manager. He succeeds **J. R. Ellis,** who retired.

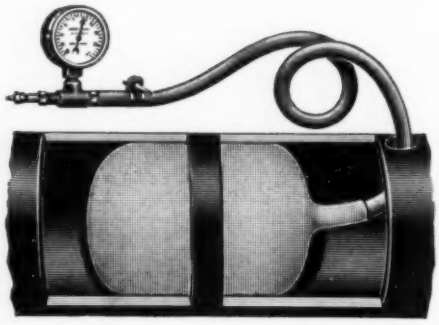
R. D. (Don) Hull has been appointed manager of engineering for **Pipe Line Technologists, Inc.** Hull has been with the engineering firm since 1957 and has worked on projects in Venezuela, Canada and the United States.

Prior to joining Pipe Line Technologists, Inc., Hull was a gas engineer with Sun Oil Company stationed in Dallas. Present headquarters are in Houston.

R. D. Hull

PIPELINE INFLATABLE STOPPERS

BALLOON-TYPE



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Higher fiber content assures more effective protection against

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Heavy soil conditions can really play havoc with pipe line coatings. That's why coatings alone can't give your lines positive protection. The answer is a protective wrapper between soil and coating to prevent transmission of soil stress. Only the best wrap will do this job effectively.

What should you look for in wrapping materials to assure maximum protection? Well, weight contributes greatly to the strength of the wrap, but the controlling factor is the type and percentage of fiber content.

Carey Asbestos Pipe Line Felt, as the diagrams indicate, has 10 times more fiber than Pipe Wrap "G." This toughens the wrapping material against continual soil stress, protects the coating and consequently prevents the exposure of the pipe to corrosive action. Carey Pipe Line Felt being composed of asbestos fiber will not rot or decay.

Before you buy pipe wrap, compare—not just weight but fiber content as well. Carey No. 15 Asbestos Pipe Line Felt or No. 8 Asbestos Pipe Line Felt (No. 8 contains 6 times more fiber than Type "G") assures you better protection and better performance from the coatings you use.

CAREY No. 15 ASBESTOS PIPELINE FELT
Total weight per 100 sq. ft.—14 pounds
Wt. of Fiber per 100 sq. ft.—10 pounds

PIPE WRAP "G"
Total weight per 100 sq. ft.—12.5 pounds
Wt. of Fiber per 100 sq. ft.—1 pound

REMEMBER,
only Carey Pipeline Felt is AccuRay* controlled for maximum protection on every inch of underground piping. Get complete information from your Carey Sales Engineer or write Dept. PL-3.

*Trademark of Industrial Nucleonics, Inc.

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The original characteristics fabricated into the coating materials by their manufacturers are protected by the use of small batch kettles, filled, heated and used in rotation at Standard Pipeprotection Inc. Prolonged heating of large batches might alter the softening point, penetration and performance characteristics of the materials.

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WHO'S MEETING WHERE

March

ASME, Gas Turbine Power Division, fifth annual gas turbine conference and exposition, Rice Hotel, Houston, March 6-9.

ASCE, national convention, Jung Hotel, New Orleans, March 7-11.

NACE, 16th annual conference, Dallas Memorial Auditorium, Dallas, March 14-18.

NGAA, Oklahoma Regional meeting, Biltmore Hotel, Oklahoma City, March 18.

Mid-West Gas Association, annual meeting, Hotel St. Paul, St. Paul, Minn., March 21-23.

IRA, National Convention, Coliseum and Waldorf-Astoria Hotel, New York, March 21-24.

New England Gas Association, annual meeting, Statler Hotel, Boston, March 24-25.

Oklahoma Utilities Association, annual convention, Biltmore Hotel, Oklahoma City, March 24-25.

April

Florida-Georgia Gas Association convention, Biltmore Hotel, Palm Beach, Fla., April 8-9.

PIEA-PESA, thirty-second annual petroleum industry conference and exhibition, Hotel Muehlebach and Municipal Auditorium, Kansas City, Mo., April 12-14.

Southwestern Gas Measurement Short Course, Drill Hall, North Campus, University of Oklahoma, April 19-21.

Indiana Gas Association, French Lick-Sheraton Hotel, French Lick, Ind., April 20-22.

Southern Gas Association, annual meeting, Galveston, Texas, April 25-27.

ASME Metals Engineering Division—AWS conference, Chase-Park Plaza, St. Louis, April 25-29.

American Welding Society, 41st annual meeting and exposition, Los Angeles, April 25-29.

NGAA, annual convention, Rice Hotel, Houston, April 27-29.

API, Division of Transportation, pipe line conference, Mayo Hotel, Tulsa, April 28-29.

May

AGA Operating Section, joint distribution and transmission conference, Roosevelt and Jung Hotels, New Orleans, May 9-13.

American Society for Metals, southwestern metal congress and exposition, Dallas, May 9-13.

Instrument Society of America, power instrumentation symposium, San Francisco, May 9-11.

ASME, oil and gas power conference and exhibit, Muehlebach Hotel, Kansas City, Mo., May 22-26.

June

Appalachian Underground Corrosion Short Course, West Virginia University, Morgantown, W. Va., June 1-3.

September

ASME, petroleum division meeting, Jung Hotel, New Orleans, Sept. 18-21.

AIEE, electrical conference of petroleum industry, Hotel Skirvin, Oklahoma City, Sept. 25-28.

October

NACE, 10th annual Western Region Conference, Sheraton-Palace Hotel, San Francisco, October 6-7.

NACE, Southeast Region Conference, Dinkler-Plaza Hotel, Atlanta, Ga., October 6-8.

BOOKS

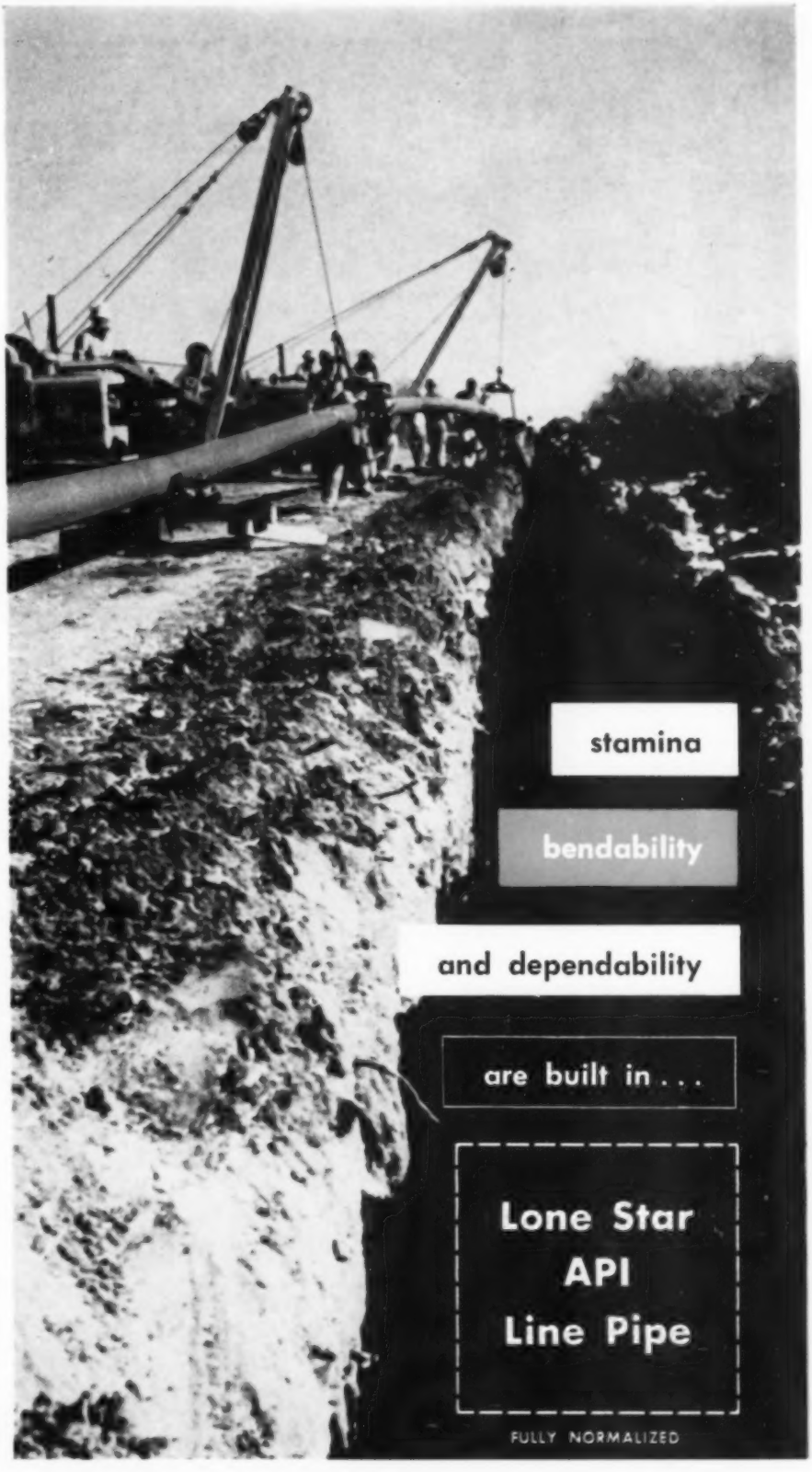
Reference Index of the Current Protective Coatings Specificatons. Ordnance Tank-Automotive Command, Detroit Arsenal, U. S. Army. 159 pages. (Order PB 151166 from OTS, U. S. Department of Commerce, Washington 25, D. C., $3.)

Federal, military, and contractor specifications for numerous protective coatings including those for aircraft, paints, metal platings, ammunition, tubing, and wheel finishes are set forth in this publication index form. Included are new specification numbers listed with the superseded or comparable specifications. Requirements, guides, and classifications accompany the specifications. Also included are charts of weights and measures, coefficients of thermal expansion, and metric equivalents.

Defense R & D Contracts Guide, Vicent F. Callahan, Evans Building, Washington 5, D.C., $25.

This is a 150-page special report on the military's $5½ billion spending program for research and development. The purpose of the nontechnical sourcebook is to provide information and advice on how and where to obtain contracts from the military services on research and development, engineering and test evaluations.

An up-to-date map showing 228 military locations which let research and development contracts is included. Also, the book contains individual state maps. Other sections of the book include information on each branch of the military service, list and reproductions of forms, and specific information and advice on how to go about getting research, development, engineering and test evaluation contracts from military installations. Editor of the guide is Jesse L. Lewis, Lt. Col., U.S. Army, Retired, who is editor of the weekly Defense R & D Contracts Report, a service for businessmen.



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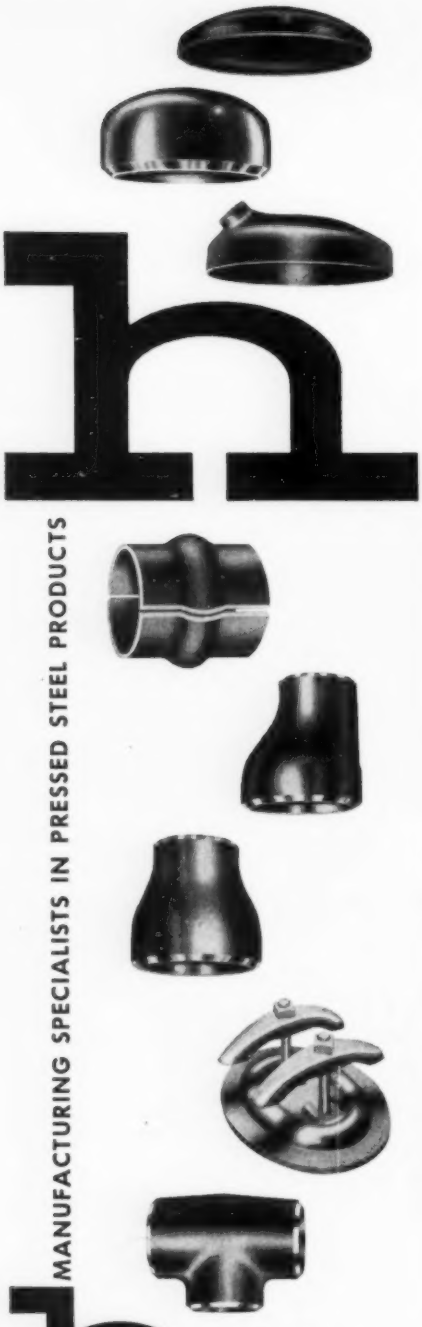

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What's Happening among SERVICE and SUPPLY MEN

Gardner-Denver Company Opens San Diego Office

Gardner-Denver has appointed Robert Scruggs manager of its new office in San Diego, Calif. Scruggs formerly had been field engineer in the Los Angeles and San Diego area for Gardner-Denver.

Robert Scruggs

Bailey Equipment Co. and newly formed San Diego Equipment & Supply Co. represent Gardner-Denver in San Diego. Gardner-Denver also opened a new experimental plant with a staff of design engineers and experimental machinists in Whittier, Calif.

International Harvester Co. Establishes Regional Offices

International Harvester Company's Construction Equipment Division has opened regional offices in New York City, Melrose Park, Ill., Dallas, and Oakland, Calif. Sales representatives at Eastern region are R. J. Winkler of New York; D. C. Steele, Leetsdale, Pa., and R. G. Moore, Atlanta, Ga. North Central regional supervisor is A. W. Meyer with headquarters at Melrose Park. Representatives include J. A. Kathrein, Omaha, Neb.; and R. K. Langdon, E. H. Hannum and G. A. Gibson, Melrose Park.

L. E. Muzzy is Southwest Region supervisor at Dallas. E. C. Price at San Marcos, Texas; and F. R. Johnson, Amarillo, Texas, are sales representatives. Western regional representatives include J. D. Reishus, Portland, Ore.; F. W. Knox, Oakland, Calif., and D. W. Rains, City of Industry, Calif.

A. W. Meyer was manufacturer sales supervisor while L. E. Muzzy had been distributor sales supervisor. Assisting C. E. Jones in directing sales of International engines is R. R. McKiel, assistant sales manager.

United States Steel Promotes Mason to Sales General Manager

Louis W. Mason has been promoted to general manager of sales for United States Steel's National Tube Division. He succeeds Robert E. Williams who became vice president of sales for National Tube.

Mason has been with the company since 1923, and he was named assistant purchasing agent in 1930. In 1942 he became manager of purchases for Tubular Alloy Steel Corporation, a subsidiary. In 1946 he was appointed district manager of sales in Detroit and later in Pittsburgh. He has served as assistant to division's general manager of sales in Pittsburgh, central area sales manager in Chicago, and in 1959, became eastern area sales manager in New York.

Roman Named General Manager of H & H Sales & Engineering Co.

Edwin A. Roman has been appointed general manager of H & H Sales & Engineering Co. The firm is a distributor of Plicoflex products. Roman served with Plicoflex for five years and became service manager before joining H & H Sales as regional manager of the Northwestern Region in New Jersey.

Roman will be in Houston and will be responsible for correlation of sales and service of the offices throughout the country.

Corrosion Rectifying Co. Names John W. Anthony Division Manager

John W. Anthony

John W. Anthony has been named manager of Corrosion Rectifying Co. Inc.'s newly created North Texas division. Formerly supervisor of corrosion control for Mobil Oil Co., Anthony will be headquartered in Dallas. He will be in charge of the company's cathodic protection installations and problems related to water handling and oil and gas facilities corrosion.

Tom Wheatley Co. Appoints Howard Crider Representative

Tom Wheatley Co. has named Howard Crider oil field manufacturers representative in the Oklahoma, Kansas and Panhandle region. Crider previously worked for Gulf Oil Corp., and Creole Petroleum Co., and has been in the oil field sales the last 10 years.

Young Radiator Company Promotes Earl J. Tessmer

Earl J. Tessmer has been promoted to assistant purchasing agent for Young Radiator Company. M. K. Nolan has been appointed sales representative to handle sales and engineering of oil field and heat transfer equipment in Texas and Louisiana.

Tessmer has been with the company for four years. Nolan formerly was with J. R. Meek Company.

"California Here We Come"

Mountains, prairie, swamp or rock . . . if it's pipelining, it can be done efficiently and on time by Houston, a prime contractor on Transwestern's new Texas to California line.

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WATER PIPELINES

CELANESE CELLULUBES used as air compressor lubricants step up safety in new missile submarines...

The advantages of Celanese Cellulubes were clearly apparent after a test program by Electric Boat Division. The tests included a study of lubricants dispersed in air under high pressure, followed by abrupt decompression. This results in a high-speed shock wave which can cause a violent explosion. Hydrocarbon lubricants proved highly vulnerable, but Cellulubes were so effective in resisting these extreme conditions that they will be used in all compressors in the new Polaris Fleet Ballistic Missile Submarines.

Cellulubes are not only outstanding for the prevention of fire and explosion, they give overall wear protection comparable to that of premium petroleum oils. The resistance of Cellulubes to carbon formation eliminates frequent scraping and cleaning of charred residues from valves and other internal parts of reciprocating compressors. Celanese Cellulubes can reduce maintenance requirements for compressors and often for downstream equipment as well. Celanese Chemical Company, a Division of Celanese Corporation of America, New York 16.

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NEW 20-PAGE MANUAL...
shows you the causes of fire and explosion in compressed air systems, based on latest research. This booklet is intended to help plant engineers and management reexamine specifications in the light of the benefits that Cellulube fire-resistant lubricants offer. Send for your copy today.

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Please send me a copy of your manual on synthetic lubricants for air compressors.

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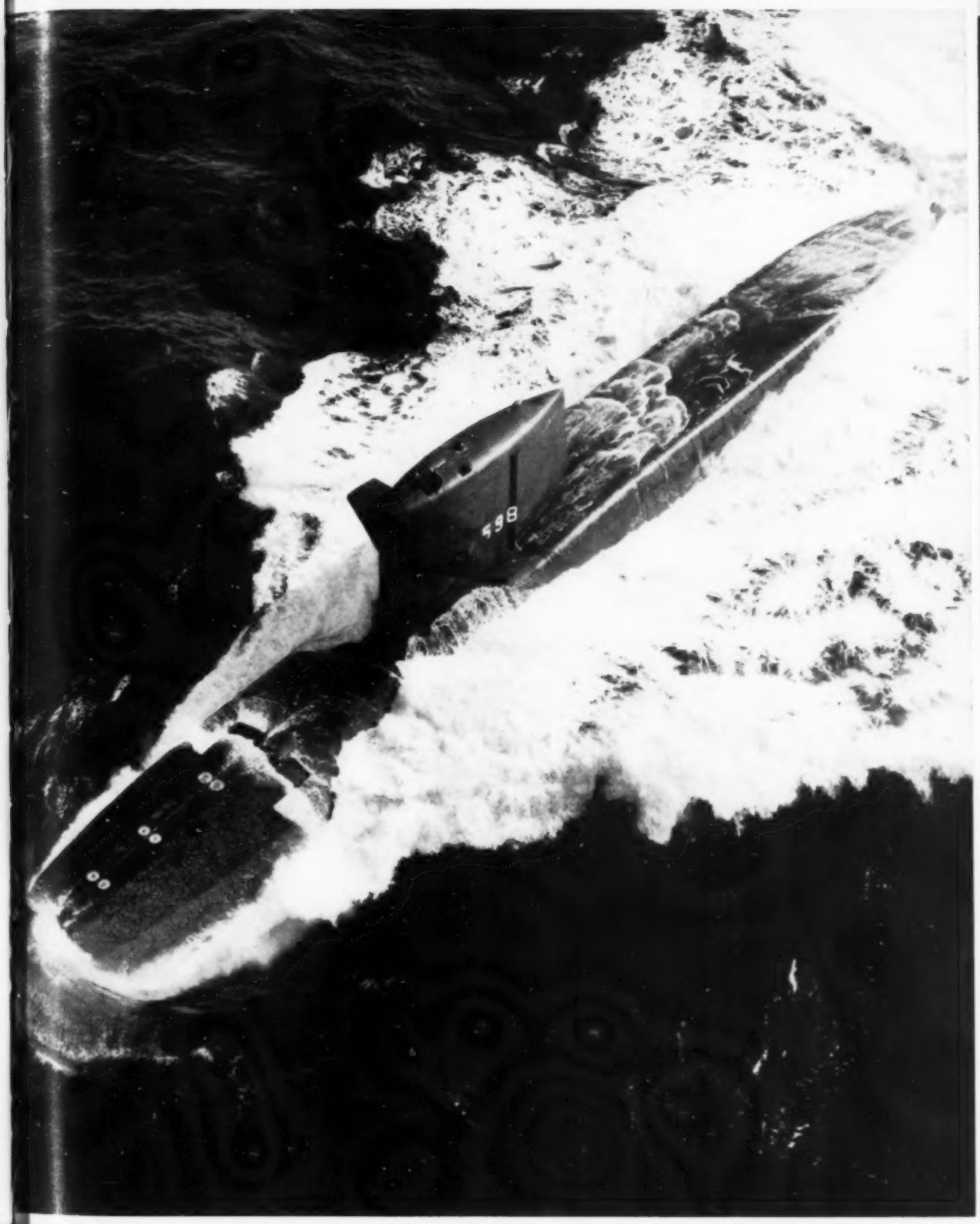

Like all other Polaris Fleet Ballistic Submarines, the U.S.S. GEORGE WASHINGTON uses Cellulube 550 for its air compressors. (Built by Electric Boat Division of General Dynamics Corporation, Groton, Conn.)

Cellulubes... Celanese CHEMICALS fire-resistant functional fluids

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CELANESE CELLULUBES

Lee Grimm Named Sales Manager Of Granberg Corp. Western Division

Lee Grimm has been appointed Western Division sales manager for Granberg Corporation, subsidiary of American Meter Co., Inc.

Grimm joined Granberg in 1950, as salesman in the Northern California area. He opened its Los Angeles sales office in 1953.

Youngstown Names DeHetre General Manager of Sales

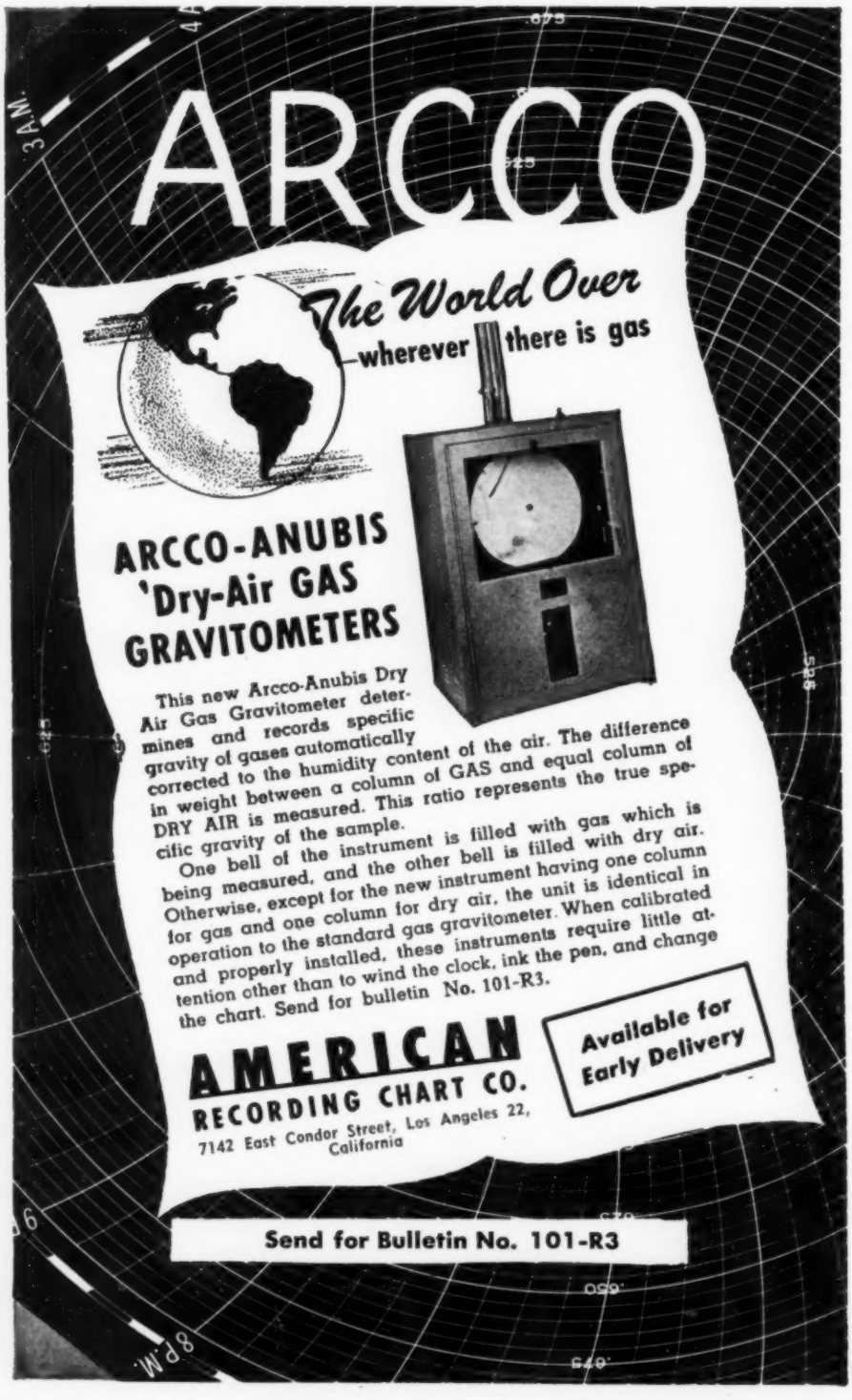
John P. DeHetre has been appointed general manager of sales for Youngstown Sheet and Tube Company. He succeeds John M. Tuthill, who retired. DeHetre has been assistant manager since 1954. He joined the firm in 1938 as assistant field engineer in Los Angeles. In 1944 he was made field engineer and in 1947 was appointed development engineer at Youngstown, Ohio.

Tuthill's retirement ends a 25-year association with the company. He had been general manager of sales since 1954.

Good-All Electric Mfg. Co. Names Wilkinson Specialist

Tom Wilkinson has been named a rectifier specialist by Good-All Electric Mfg. Co. Formerly, Wilkinson had been with D. E. Stearns Company. He will contribute to Good-All cathodic protection rectifier line.

Prior to his work as sales manager with Stearns, he had spent several years in the design and sales of cathodic protection rectifiers.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The World Over
wherever there is gas
ARCCO-ANUBIS
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GRAVITOMETERS
This new Arcco-Anubis Dry Air Gas Gravitometer determines and records specific gravity of gases automatically corrected to the humidity content of the air. The difference in weight between a column of GAS and equal column of DRY AIR is measured. This ratio represents the true specific gravity of the sample.
One bell of the instrument is filled with gas which is being measured, and the other bell is filled with dry air. Otherwise, except for the new instrument having one column for gas and one column for dry air, the unit is identical in operation to the standard gas gravitometer. When calibrated and properly installed, these instruments require little attention other than to wind the clock, ink the pen, and change the chart. Send for bulletin No. 101-R3.
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Available for Early Delivery
Send for Bulletin No. 101-R3

R. H. Van Bergen

R. M. Boone

Cooper-Bessemer Corporation Announces District Appointments

Cooper-Bessemer has appointed Richard H. Van Bergen sales engineer in the New York branch office. R. M. Boone has been transferred to the Odessa, Texas, office.

Since 1956, Van Bergen had been in the Sales Department at company headquarters in Mount Vernon, Ohio. In his new position he will work under the immediate supervision of C. J. Havekotte, New York branch manager, on application and sales of Cooper-Bessemer compressors and engines. Boone had been in Mount Vernon since 1957. He will work under supervision of C. L. McDougall at Odessa.

Insul-Mastic, Inc., Appoints Richard R. Rue Plant Manager

Insul-Mastic, Inc., has appointed Richard R. Rue plant manager of the Protective Coating Division of Pittsburg Coke & Chemical Company. Rue formerly was a director of research for Insul-Mastic. He joined the division in 1952 as a technical director of laboratories. Previously he had been with Pure Oil Company.

Reilly Tar & Chemical Names Robt. Gilliland Sales Engineer

Robert Gilliland has been named sales engineer for Reilly Tar & Chemical Corporation and will be located in Houston sales office. Gilliland will be a representative in the coal-tar enamel pipe line coating division.

Lett Named Export Sales Manager Of Burndy Corp.'s U-I Division

William E. Lett has been appointed export sales manager of Burndy Corporation's Utility-Industrial Division. From 1952 to 1959, Lett had been export sales manager of Noranda Copper and Brass Limited.

J. I. Case Company Elects Wm. J. Grede New President

J. I. Case Company has elected Wm. J. Grede president of the company succeeding Marc. B. Rotjman who becomes special advisor to the president and Case Executive Committee.

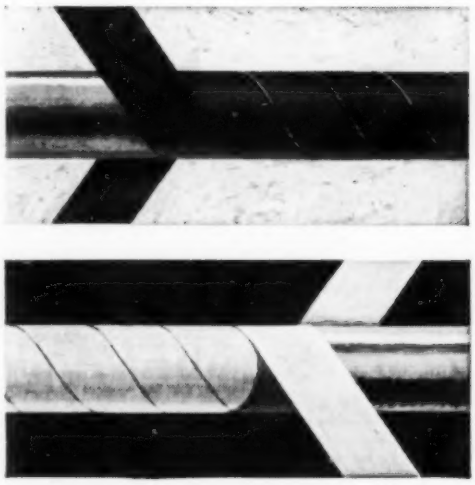
Grede is former president of Grede Foundries, Inc. He has been head of Case Executive Committee since 1956.

Walworth Company Changes Tradename on Valve Line

Walworth Company has renamed one of its lines of valves. "Rolotork" now will designate its high pressure, steel, ball-bearing lubricated plug valves.

For more data on advertised products, use Readers' Service Cards, last page.

PROTECTION
is our business



The finest protection that nature and science, working together, can provide for your pipe lines is found in Nicolet Asbestos Pipe Line Felts.

From Nicolet's mines, through quality controled manufacture, to final shipment for mill wrap or over-the-ditch application, every step is calculated to give you the best in quality, performance and economy.

You can choose either the popular #15 "Standard" or the #8 "Tufbestos" with equal confidence. Both are Tar or Asphalt saturated Asbestos, Glass Reinforced, Perforated or Non-perforated. The #15 "Standard" is also available without Glass Reinforcement.

Or, your requirements may indicate Nicolet "Reflecto" Asbestos Pipe Line Felt. This is a white wrap that is capable of reducing enamel temperatures as much as 30%. It is strong, tough and light weight—a wrap that handles easily and is economical to ship. It has built-in resistance to shock and scuff and is Glass Reinforced and Perforated.

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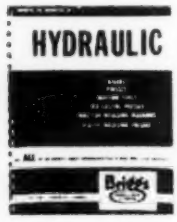
HERE is a big 8½" x 11", file size, 12 page, fully illustrated booklet. It's brimful of technical data and drawings that every designer and operating engineer will want to read or keep for ready reference. Write for your copy. No obligation.



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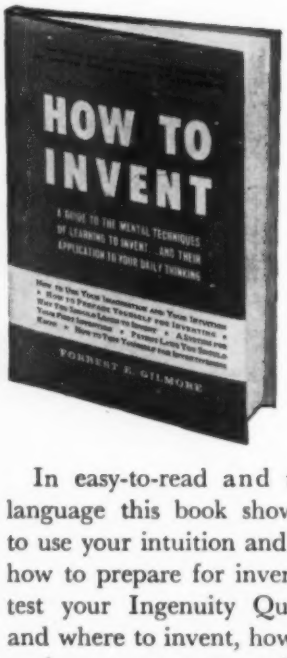

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A guide to the mental techniques of learning to invent . . . and their application to your daily thinking.

In easy-to-read and understand language this book shows you: how to use your intuition and imagination, how to prepare for invention, how to test your Ingenuity Quotient, when and where to invent, how to find time to invent, ways to profit from your invention, how to record your observations, why some potential inventors fail.

The book also contains a detailed discussion of patent practices you should know such as: how to decide what is patentable, how to go about obtaining a patent, what a patent really means, how to protect your patent from the beginning.

Order from your bookstore, or:

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P. O. Box 2608, Houston 1, Texas

San Diego Equipment & Supply Co. Names Gallagher General Manager

J. W. Gallagher has been named general manager of the newly formed San Diego Equipment & Supply Co. which has completed construction of a warehouse and sales office at 5901 Mission Gorge Road in San Diego. The firm represents Gardner-Denver Company, Bay City Shovel Co. and Rock Bit Division of Timken Roller Bearing Co.

J. W. Gallagher

Gallagher formerly served as field engineer for the Gardner-Denver Co. in various sections of the United States, Canada and South America. San Diego Supply & Equipment Co. has received delivery of over $200,000 of new construction equipment which is available for sale, rental, lease or purchase.

Midwestern Pipe Line Products Co. Appointed Polyken Tape Distributor

Midwestern Pipe Line Company has been appointed a franchised distributor of Polyken Protective Tape coatings by the Kendall Company. Midwestern sales and service offices will be available with Polyken engineering and service forces. The company also will represent the Tapester and REMCO, pipe wrapping machines.

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500,000 ft. 10¾" O.D. 35#
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100,000 ft. 12¾" O.D. 40#
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GE Computer Department Announces Three Top Managerial Appointments

General Electric Company's Computer Department announces three key appointments. Kenneth R. Geiser, former manager of engineering, is manager of the department's newly-organized business planning operation. Dr. Robert R. Johnson, is now manager of engineering; formerly he was manager of the laboratory at Palo Alto, Calif. Dr. Helmut M. Sassenfeld, former manager of operations for the Huntsville, Ala., center, has been made manager of the newly-formed applications section.

Several other appointments have been made in the company's Computer Department. Robert A. Daskam has been appointed manager of application engineering for internal data processing computers. Lawrence D. Goldsmith was named manager of application engineering for business data-processing equipment, and Tsai Hwa Lee, becomes manager of application engineering for industrial process computers.

Smith-Erie Division Appoints Leisenring Director of Marketing

H. D. Leisenring has been appointed director of marketing for Smith-Erie Division of A. O. Smith Corporation. Formerly general sales manager, Leisenring will continue in charge of sales and will be responsible for all marketing functions.

H. D. Leisenring

William B. Johnson becomes sales promotion manager and assistant to director of marketing; John B. Thompson is new sales manager of special products, and J. W. Harris becomes sales manager of meter products. Johnson will be responsible for advertising, catalogs and literature. Thompson will supervise field tests, market surveys and establishment of sales policies for special products. Harris will supervise filter products in addition to meters.

Electric Steel Foundry Co. Promotes Jefferson J. Davis

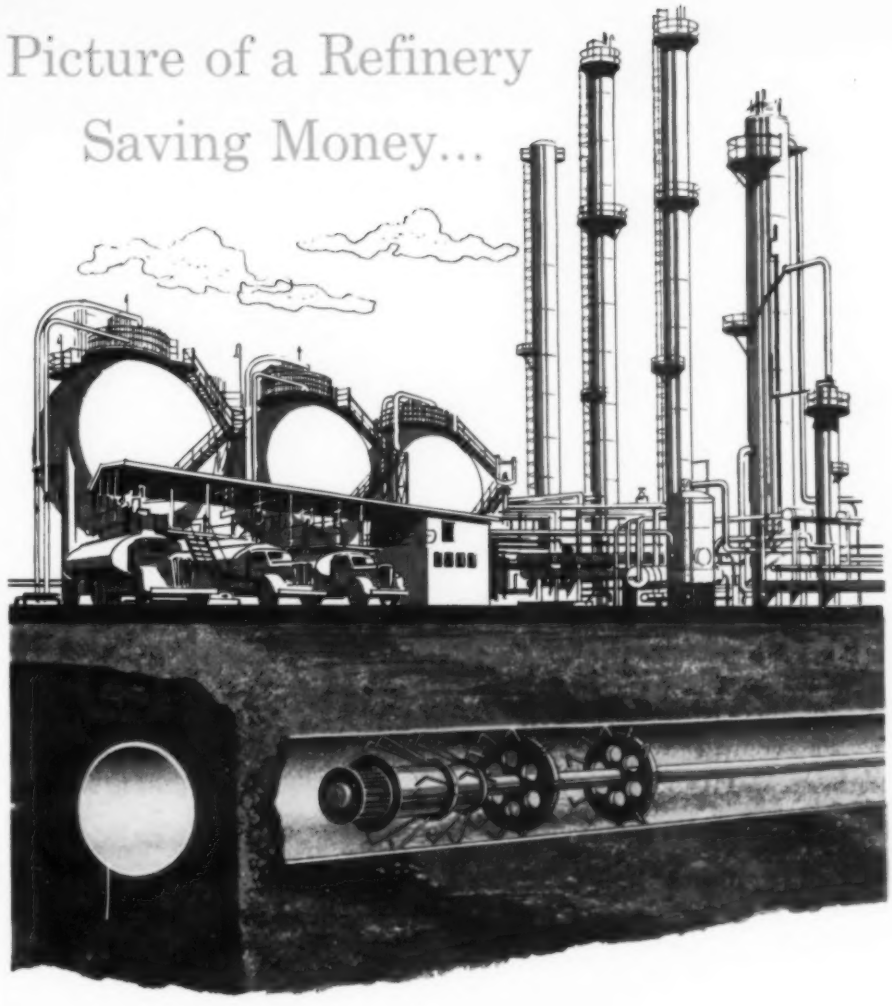
Jefferson J. Davis, formerly vice president in charge of Products Division at Electric Steel Foundry Company, has been elected executive vice president.

Davis has been with the company for 24 years. He joined ESCO-Seattle as office manager in 1936. He was later manager at ESCO-Eugene, manager of Logging, Sawmill, Crushing and Construction Equipment Divisions. He was named a vice president in 1954.

ACF Industries Appoints Foreign Operations Director

Raymond P. Charnaux has been named director of foreign operations for the ACF Industries Incorporated. He will coordinate the activities of the ACF operating divisions in licensing and marketing the company's products abroad.

Before joining the company, Charnaux had been with Yale and Towne's international operations. Prior to that he managed international operations for Robertshaw-Fulton Controls Co. and later a vice president.



Spunline Relines Pipe Lines in-place without removing the pipe

Another refinery, it could be in Texas, California or Montana, will soon be enjoying the savings of another rehabilitated pipe line. The flow will increase, the pumping cost will drop and the pipe line will be good as new for at least another quarter of a century.

And traffic will move without interruption or inconvenience to the public.

Spunline® is applicable to pipe lines down to 4" and may be used in cast iron, steel, concrete and wrought iron pipe lines.

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Subsidiary of American Pipe and Construction Co.

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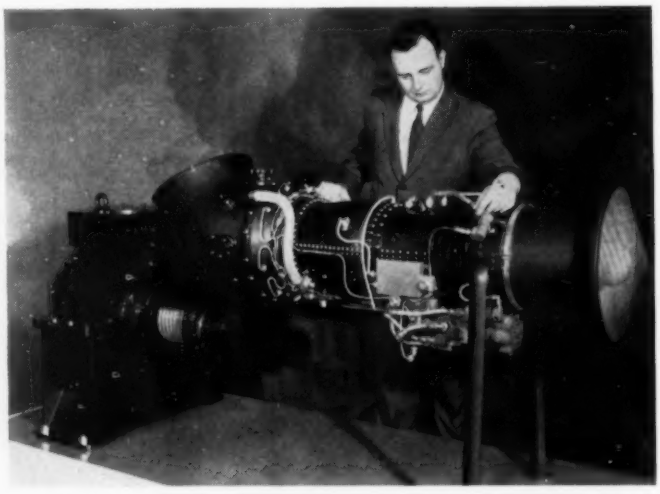
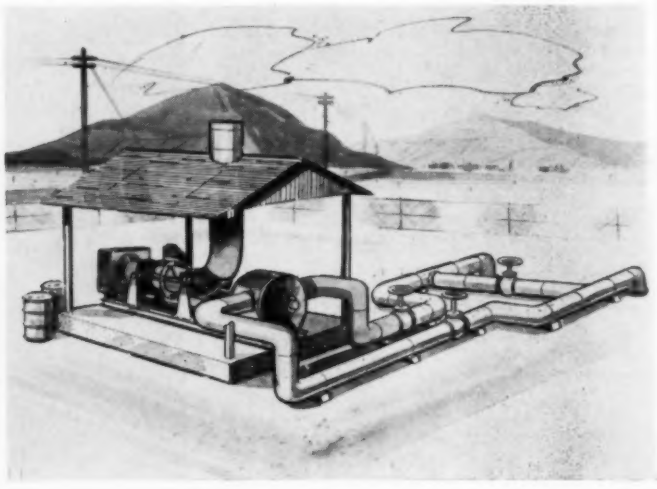
What's New in EQUIPMENT

To receive more information on all new equipment articles use Readers' Service Card, last page of this issue.





General Electric Introduces New Turbine Engine

General Electric announces development of a new gas turbine Model 720/722 engine which is a smaller unit than its present turbines. The turbine, which develops maximum continuous rating of 900-shaft horsepower, weighs only 300 pounds, not including reduction gearing unit.

The Model 722 will be installed in a Trunkline Gas Company compressor station for a one-year test. The unit will drive a DeLaval double-shaft, centrifugal unit.

The turbine design is derived from General Electric's T58 turboshaft engine which has accumulated more than 26,000 hours of running time in development as a helicopter plant. The gas turbine also is being used as a power plant in two marine crafts.

With small size of the turbine, maintenance and construction are simplified and less costly. For repairs the unit can be detached from the reduction gear and another engine can be attached in a few hours to keep the station on line.

(This item supplements General Electric Company data on pages 199-202 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Automatic Control Panels

Clark Bros. Co. has introduced a new series of automatic control panels to simplify operation of its HMB-EMB packaged field compressor. A completely pneumatic starting and stopping system operates on 75 psi air or gas pressure. Each panel is designed to match the operating characteristics of the compressor and is run off on test with the unit to assure reliable performance prior to delivery.

The panels allow operator to start and stop engine with the push of a button. All functions are sequenced in a pre-determined, automatic cycle. Control panels can be stationary mounted or rubber shock mounted on the compressor skid. A digital annunciator system or pop-up indicator buttons can be provided on the panel to show the cause of a shutdown.

(This item supplements Clark Bros. Co. data on pages 89-92 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Full-Encirclement Saddle

A full-encirclement saddle for existing lines is announced by Steel Forgings, Inc.

The saddle can be installed without bell hole excavation; saddles must be split through nozzle and are commonly split 180° from the nozzle.

In case of a buried existing line with an ascending vertical lateral, saddle can be installed with enough excavation to permit the bottom half to be slipped around and under the main line. All welding is from top and sides.

(This item supplements Steel Forgings, Inc., data on pages 408-409 in the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

Caulking Compound

A new caulking compound with a life expectancy of 30 years has been introduced by The Farboil Company. The product, Farboil Epothane Farbo-Flex, remains permanently flexible on the exterior or interior and is designed to withstand extreme continuous expansion and contraction when exposed at temperatures from minus 65° to 300° F.

Adhesion is fusion-like and is not impaired by impact, vibration, contraction or expansion.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

KENTUCKY PIPELINE CONSTRUCTION JOB SAVES TIME AND MONEY WITH ROSKOTE COLD-APPLIED MASTICS

Petroleum Exploration, Inc., specified the application of ROSKOTE PIPE MASTICS, by the ROSKOTER method in the construction of its new transmission pipeline from Manchester to London, Kentucky.

The results —

Dollar Savings by

elimination of heating fuel costs, loss from spillage, kettle operation and haulage.

reduction in size of coating crew, and amount of equipment required.

Time Savings resulting from

the continuous and steady application of two coats of quick-drying mastic with the ROSKOTER "minimum crew" coating device.

Superior Protection from Corrosion

because ROSKOTE MASTICS form a flexible pipe coating that is highly resistant to electrolytic action, deformation by soil stress, thermal influences and attack by moisture, acids, alkalies and salts.

Pipeline built from Manchester, Ky., to serve London, Ky.
Engineers: Petroleum Exploration, Inc., Lexington, Ky., and Sistersville, W. Va.
Contractor: Cumberland Contracting Co., Monticello, Ky.

These same savings and benefits can be achieved on your next pipeline project through the use of ROSKOTE COLD-APPLIED PIPE MASTICS. More than 400 gas and oil companies currently use these pipeline coatings which are adaptable for any application method such as brush, spray, glove or line travel operation to lines of any length and diameter.

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For more data on advertised products, use Readers' Service Cards, last page.

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Complete stocks of Petroleum Gaging Equipment meeting all API and ASTM specifications are maintained for immediate delivery by W. H. Curtin & Co. Curtin oil testing centrifuges and tubes, thermometers and hydrometers, as well as all other gaging equipment, are of the finest quality and constructed for a long lifetime of use in field or laboratory. Replacement parts are readily available for all equipment. On your next order, specify the high quality gaging equipment you can rely on from W. H. Curtin & Co.

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Established 1922 U.S.A.

Traxcavator

Caterpillar Tractor Co. announces its No. 944 Traxcavator, first of an all-new line of wheel loaders produced by the company. A safety feature of this unit is location of all lift arms and hydraulic cylinders ahead of the operator's compartment. It is powered by gasoline or diesel and fitted with a 2-cubic yard capacity bucket. Engines are rated at 105 horsepower.

The power train of No. 944 includes a power shift transmission, which is a two-speed forward, two-speed reverse, planetary transmission. It consists of four in-line gear trains, each with a separate clutch. Control of machine direction and speed is afforded by two control levers. The steering system is hydraulically boosted.

(This item supplements Caterpillar Tractor Co. data on pages 76-79 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

Small Trencher

Designed to dig 4-inch wide trench 66 inches deep or a 12-inch wide trench, 30 inches deep, the Davis T-66 is being introduced by Davis Mfg., Inc.

Positive traction is obtained by use of tracks which eliminate tendency to bounce. A hydraulically-driven two-speed gear reduction transmits power to positive-acting drive clutches. Trenching speed varies from one to 12-feet per minute. The unit is powered by a 12.5-horsepower air-cooled engine. Drive arrangement permits the operator to distribute available power to either the digging chain or to the drive, depending upon soil conditions and size of trench.

The machine does its own backfilling. Backfill blade attaches to the boom and is operated hydraulically. A special trailer to transport the unit is also available.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Simplified Valves

A new extremely simple and compact valve has been announced by Grove Valve & Regulator Company. The G-5 valve is available in both lever operated and hand wheel operated models, in sizes from 2 to 36 inches in diameter. The valve provides a seal on the upstream and downstream sides of the gate.

hot countdown . . . cool blastoff

sophisticated piping systems use BONNEY SWEEPOLETS for branch connections

Bonney Sweepolets are in use on the Saturn missile launching pad on the high velocity water cooling system of the blast deflector. The long sweep of the Sweepolet provides maximum fluid flow and its sophisticated design provides optimum stress distribution. For all piping systems involving unusual or complex stresses at branch connections, you will be wise to specify Bonney Sweepolets. Write for catalog S-1A.

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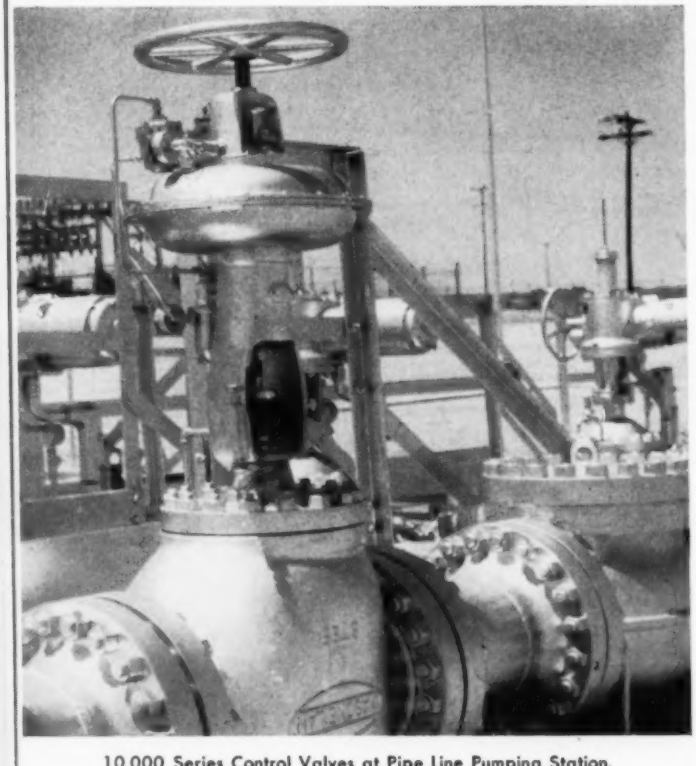
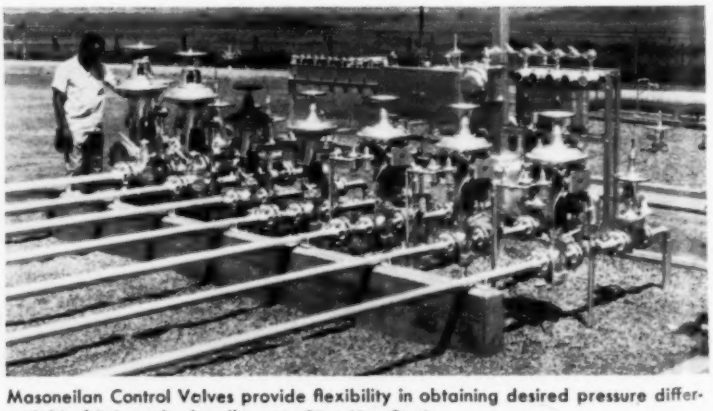
For more data on advertised products, use Readers' Service Cards, last page.

Masoneilan Butterfly Valves, equipped with pneumatic positioner, used on gas pipe line auxiliaries.

Masoneilan Percentage Piston Control Valves with Series 2800 Controllers.

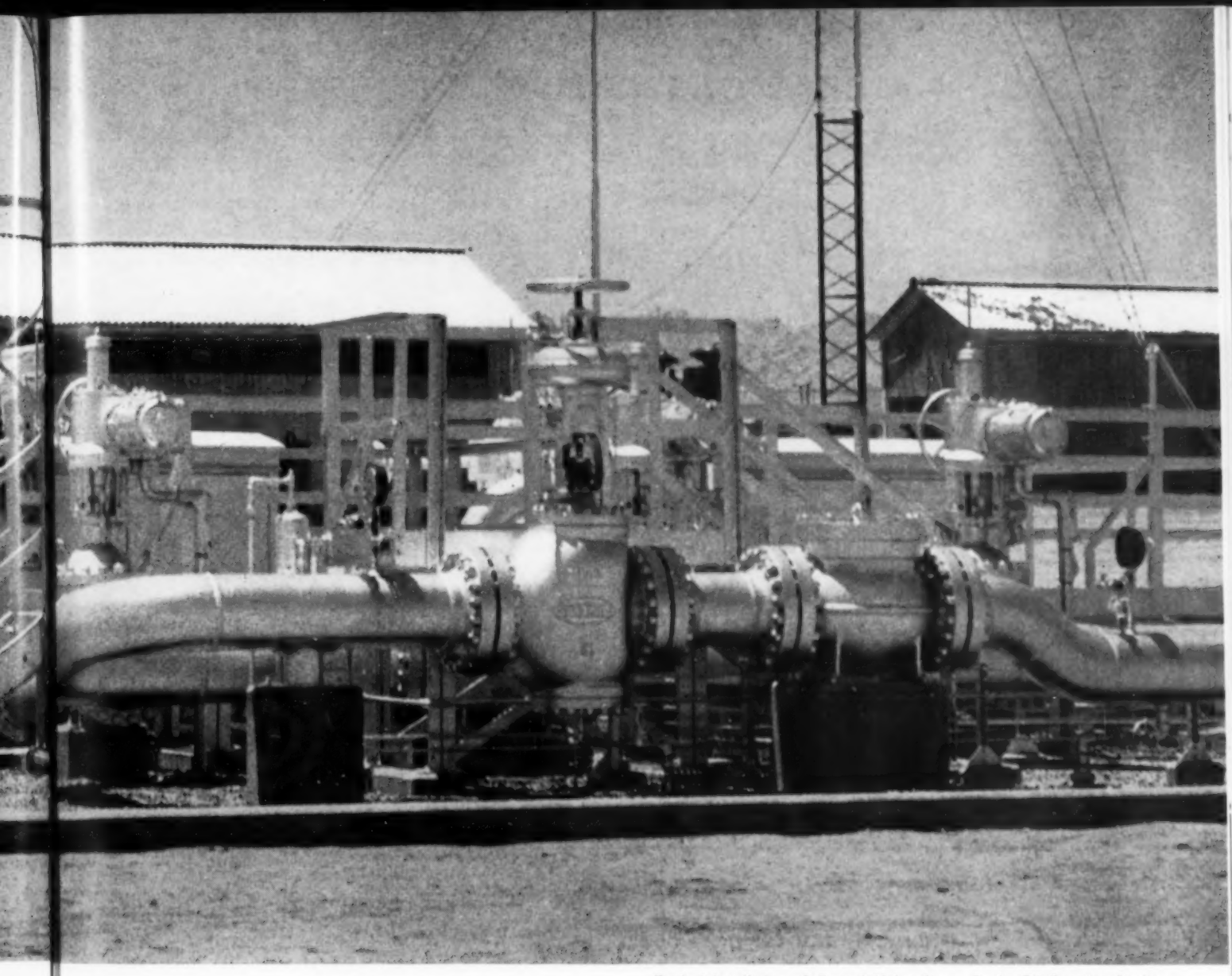


10,000 Series Control Valves at Pipe Line Pumping Station.



Masoneilan Control Valves provide flexibility in obtaining desired pressure differential in friction tube bundles at a Pipe Line Station.

2700 Series Controllers mounted on 10,000 Series Control Valves.



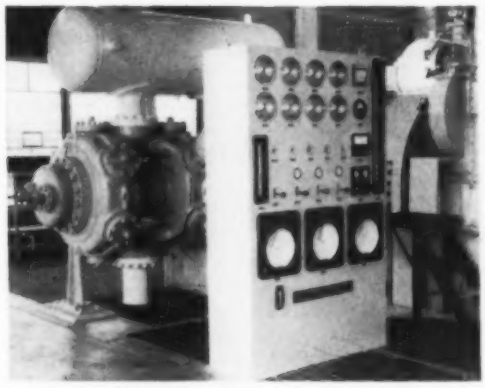
Typical installation of Control Valve for a Crude Oil Pumping Station.

Masoneilan Controls Demonstrate Dependability in Modern Pipeline Operation

Masoneilan Controls — instruments, control valves and auxiliary equipment — are demonstrating the dependable, low-maintenance service required for profitable pipeline operation. Remote station control, and other modern concepts designed to obtain operating simplicity and economy, demand this top dependability.

Versatility in application of standard Masoneilan products affords further opportunities for cost-saving. Extensive pipeline control experience enables Mason-Neilan engineers to exploit this versatility to your advantage.

For product data and application assistance, contact a Mason-Neilan representative, or write:



Masoneilan 60000 Series Instruments are used to control pressure at Compressor Stations for gas pipe lines.

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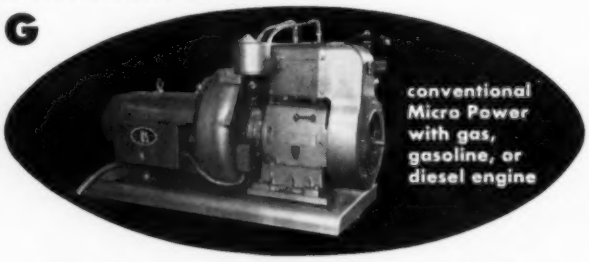
assured of 100% reliable microwave communications with . . .

AMAZING MICRO POWER



Heart of the microwave communications link between the Williams and the Seligman, Arizona, compressor station of El Paso Natural Gas Company is a United States Motors Corporation Micro Power. The engine of the conventional Micro Power in this case is replaced by a DC motor which is fed from the station batteries, from which all supervisory and telemetering equipment operates. Should the AC commercial power fail, the Micro Power continues to supply the microwave without voltage drop, droop, or break. Micro Power operates from, but isolates the microwave from the commercial power and removes the bad effects of voltage dips and peaks.

MICRO POWER operates with the main source of power. There are no transfer switches, no starting batteries with Micro Power. Available in 1500, 3000, 5000 and 10,000 watt capacities; for gas, gasoline or diesel engine emergency drive. For complete information, write . . .

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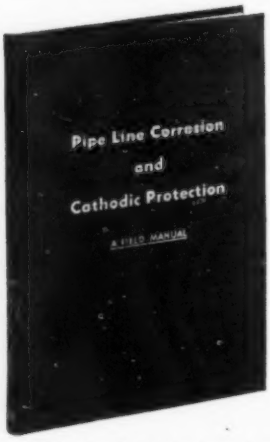

The most practical on-the-job manual for men concerned with pipe line corrosion.

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This book is designed as a practical field manual. It provides workable methods that can save you valuable time and effort in obtaining interpretive field data.

Contents (Condensed). Soil Resistivity Surveys, Pipe-to-Soil Potentials, Line Currents, Current Requirement Surveys, Rectifier System for Coated Lines, Ground Bed Design and Installation, Magnesium Anodes on Coated Lines, Hot Spot Detection, Stray Current Electrolysis, Interference in Cathodic Protection, Operation and Maintenance, Coating Inspection and Testing.

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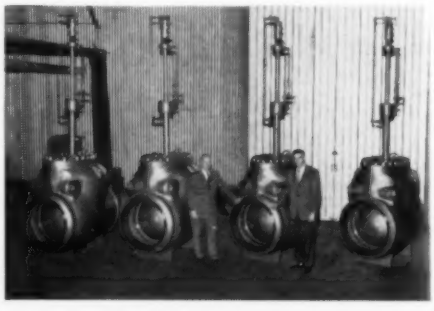
Metal seat rings are in constant contact with chrome plated body side plates guaranteeing continuous scraping action through all gate positions. When in open position, the G-5 O-Ring is completely removed from the flow preventing damage from foreign matter in the flow line. Other features include a bleeder plug which permits venting of body cavity with the valve in the closed position and powerful springs which hold both metal seat rings against the body side plates.

(This item supplements Grove Valve & Regulator Co. data on pages 213-224 of the Pipe Line Catalog, Second Revision.)

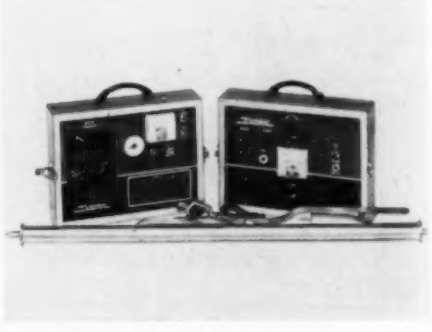
For more data, circle **No. E7** on Readers' Service Card, last page this issue.



Check Valves

Frank Wheatley Pump & Valve Mfr. has completed production on large number of 30-inch synthetic seal swing check valves. Weighing 12,000 pounds each, the valves are ASA-600 steel horizontal swing check valves with synthetic rubber seals, weld ends for natural gas service. Valves feature a hydraulic control system designed to minimize slam and movement of the clapper.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.



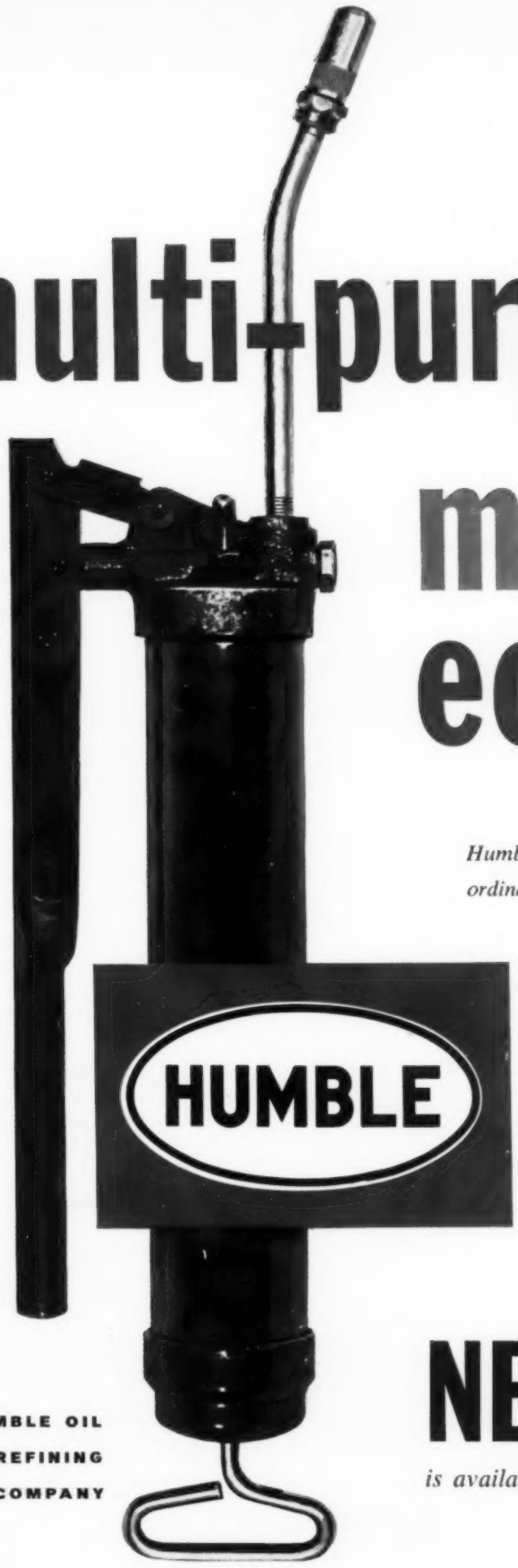
Transistor Pipe Detector

Computer Measurements Company announces a new transistor pipe detector, the Detectron Model 808. Two transistors are used so that maximum power is available with no sacrifice of stability. This assures exceptionally long transistors life.

The unit is designed to detect and trace pipes, cables, conduits, etc., and to locate valve boxes, services, studs and miscellaneous metallic objects. Depth of pipe can be estimated by triangulation.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

multi-purpose= maximum economy



Humble NEBULA EP-1 multi-use grease replaces several ordinary greases and gives you these economies:

- You buy one grease in quantity—save on quantity discounts;
- Your storage requirements are kept to a minimum;
- Your record keeping and inventory are simplified;
- You always have the *right* grease handy.

NEBULA EP-1 is top choice for the tough jobs because of its exceptional resistance to the effects of heat, water, oxidation and heavy loads. Order NEBULA EP-1 from your nearest Humble bulk plant in Texas, New Mexico and Arizona. Other areas contact Humble Oil & Refining Company, Houston, Texas.

NEBULA EP-1

is available in pails, drums and in handy cartridges.

HUMBLE OIL & REFINING COMPANY

Tractor Attachments

Development of a subframe and equipment hydraulic package on Ford Motor Company tractors makes it possible to mount Ford "super-duty" loader, backhoe or counterweight boxes.

The loader is a new item in the Ford industrial line. It has a lift capacity of 2,500 pounds and a breakaway capacity of 5,500 pounds. Power for loader comes from independent universal hydraulic power package. This separate system provides fast bucket operation at rated engine speed. A material fork, industrial fork lift attachment, crane, dozer blade and bucket and blade scarifiers are also available for other needs.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

STOP PIPING CORROSION

with UPVC piping products

Manufactured by

Tube Turns Plastics, Inc.,

Louisville, Ky.

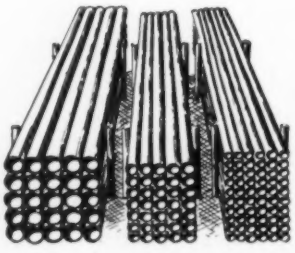
We carry a full stock of this leading brand of *tlp fittings, flanges, valves and specialties... also UPVC pipe.

Call us for a copy of Tube Turns Plastics' Catalog 119, **which includes valuable data on UPVC (unplasticized polyvinyl chloride) piping design, installation.**

***"tlp" is a Trademark of Tube Turns Plastics, Inc.**

RIGID POLYVINYL CHLORIDE PIPE

IN STOCK: normal PVC pipe ¼" through 6" in SCH-80, ¼" through 4" in SCH-40, to solve tough liquid and gas handling problems for industry.



Non-ageing, non-toxic, odorless, tasteless, and *chemically inert,* PVC pipe is easily worked and assembled with conventional equipment and provides high structural strength, (tensile strength of 5500 to 7000 psi) low initial cost, low maintenance cost, and extremely long life.

MECO
MAINTENANCE Engineering CORPORATION
P. O. BOX 2627 2711 CLINTON DRIVE
PHONE CA 2-2351 HOUSTON 26, TEXAS

Scraper Indicator

A newly designed scraper passage indicator has been introduced by T. D. Williamson, Inc. Working on the same principle as other Williamson pig-sigs, (a trigger extends through pipe wall) the new indicator is more compact and can be installed under line pressure. The long trigger detects scrapers in oversize pipe or scraper traps. Operation directions may be changed under pressure. It has accurate "repeatability" suitable for metering or calibration.

(This item supplements T. D. Williamson, Inc., data on pages 529-532 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

Ribbon Indicator

Swartwout Division, Crane Co. has introduced a new electronic ribbon indicator. Designed for use in regular panels where space is limited, or in graphic panel installations, the small unit can be mounted vertically or in horizontal position.

The A22M unit is simple and compact. The ribbon-drive mechanism and amplifier are mounted on the main chassis. The amplifier assembly is a self-contained unit that can be removed if replacement is necessary.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

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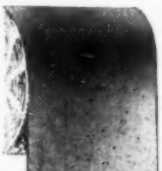


THE S. D. DAY COMPANY

MANUFACTURER'S REPRESENTATIVE FOR:

PITTSBURGH COKE & CHEMICAL CO.
Pitt Chem Hot Applied Enamels
Pitt Chem Cold Applied Coatings including Tarset

THE RUBEROID COMPANY
Pipe Line Felts • Rock Shield
Inner and Outer Glass Pipe Wrap

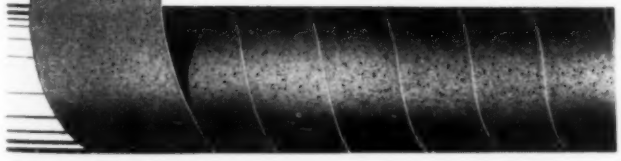
Distributor in the Southwest for:

FIELDJOINTER*
for land use
(Manufactured by American Coating Supply Co.)

MANUFACTURERS OF:

FORMULA 291
Skin Saver

*Fieldjointer Patent No. 2763047



"serving all pipelines"

S. D. DAY COMPANY
3115 BUFFALO DR., HOUSTON 19, TEXAS
PHONE JA 8-2431

Now! More Dead Weeds and Brush per Dollar

with UROX® WEED KILLER

One Application Gives 8 to 18 Month Control!

Here's the weed killer you can *positively depend on* to wipe out weeds and brush faster, easier, at lower cost and for a longer time than you ever thought possible. Urox weed killer effectively handles weed killing jobs along pipelines, on tank farms, around refineries and pumping stations, where weeds and brush are a constant fire hazard. In all these places, *just one application of Urox weed killer will remain effective for as long as 8 to 18 months!*

Longer lasting! Saves time and money! Urox weed killer has a cumulative effect on weeds and brush. Its herbicidal action can thus be extended from one year to the next with light booster doses. As smaller amounts are used over a period of time, you realize substantial savings.

Easy to use! *Liquid Urox* weed killer is ideal for spraying large overgrown areas. It won't clog spray nozzles or strainers! Won't precipitate out in the tank! Stays in solution perfectly! *Granular Urox* weed killer is the convenient inexpensive way to treat small weed-infested areas. Can be applied easily with any mechanical or hand-operated spreader.

New Urab® weed killer kills deep-rooted brush and weed trees! If you have problems with tough, deep-rooted weeds, brush or weed trees, *New Urab Weed Killer* is just what you're looking for. Urab weed killer actually *penetrates soil* to kill deep roots. Does what no other herbicide can! Supplied in liquid and granular forms.

*Trademark of Allied Chemical Corporation

Get the whole story! Mail this coupon!

Allied Chemical

GENERAL CHEMICAL DIVISION
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Weed Killer Dept. PI-30
GENERAL CHEMICAL DIVISION
Allied Chemical Corporation
40 Rector Street, New York 6, N. Y.

☐ Please send me more information about General Chemical's amazing new herbicides, Urox and Urab.

☐ Please have representative phone for appointment.

Name _____

Title _____

Company _____

Address _____

City _____ Zone _____ State _____

New BIG-LIFT,

105 hp TD-15 Sideboom gives

Only the new International Superior SBI-150-BH sideboom lifts 46,500 lb at 4'. It's powered and platformed by the new TD-15 six-cylinder, 105-hp Pipeliner's Special crawler!

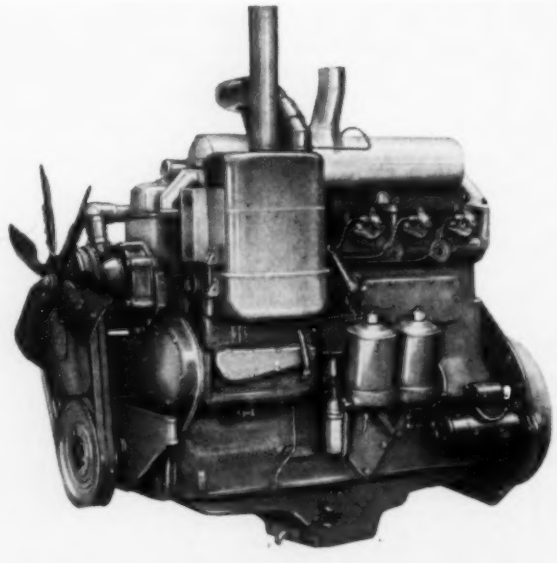
Industry-topping undercarriage strength backs the biggest lift in the 100-hp class. Precision welded box beams, joined by heavy-duty steel gussets and anchored by ¾" steel plate, form the TD-15's Dura Roller-equipped track frames!

In the TD-15 sideboom you get a 6-speed full-reverse transmission. Change gears, and change forward-reverse directions, with one fast hand sweep of the "single-stick" shift lever and the Shuttle-Bar—to suit every job condition. Use the "15's" decelerator to position pipe with precision!

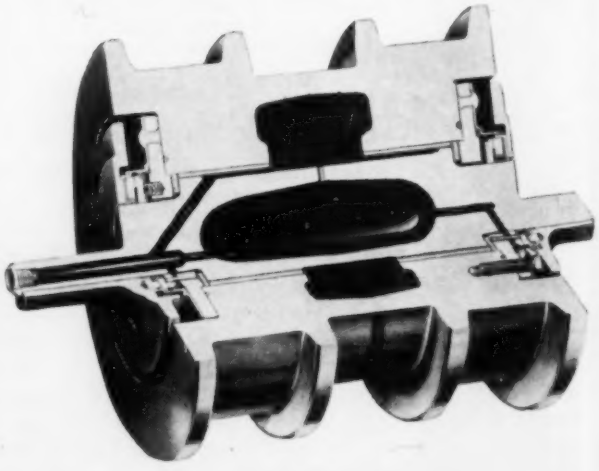
Cross-country fitness!
This 105-hp rig gives you 6-roller, rigid-track traction with 28 square feet of track-on-ground flotation—and 74" gauge hill-hugging stability. High-clearance sideboom hinge points provide maximum clearance in soft footing. Underside design is clean. Engine and transmission guards are completely enclosed for positive protection!

Individual gear-driven drum shafts contribute to long and quiet TD-15 sideboom working life, and wear-saving cable alignment. Horizontal control levers are vertically-stacked for operating ease and safety. Fleeting sheaves prolong cable life by preventing piling or crushing. Change counterweights with speed and ease!

You get the smooth power and big-load wallop of the millions-of-hours—proved International D-554 diesel—in the TD-15 sideboom. This high-torque 6-cylinder engine develops 105 net hp at 1,650 rpm. And the TD-15 gives you the power-transfer efficiency and dependability of a *dry-type* sintered metal engine clutch that needs no "cooling system"!



Heavy-duty TD-15 1,000-hr. lube interval track rollers are designed to defy the "eat-'em-alive" pipelining "grind"! They're called Dura Rollers—feature the industry's thickest shells, king-sized lube reservoirs, and full-floating, precision-fitted seals. Pressure relief passages let you power-lubricate Dura Rollers —with positive safety to seals!

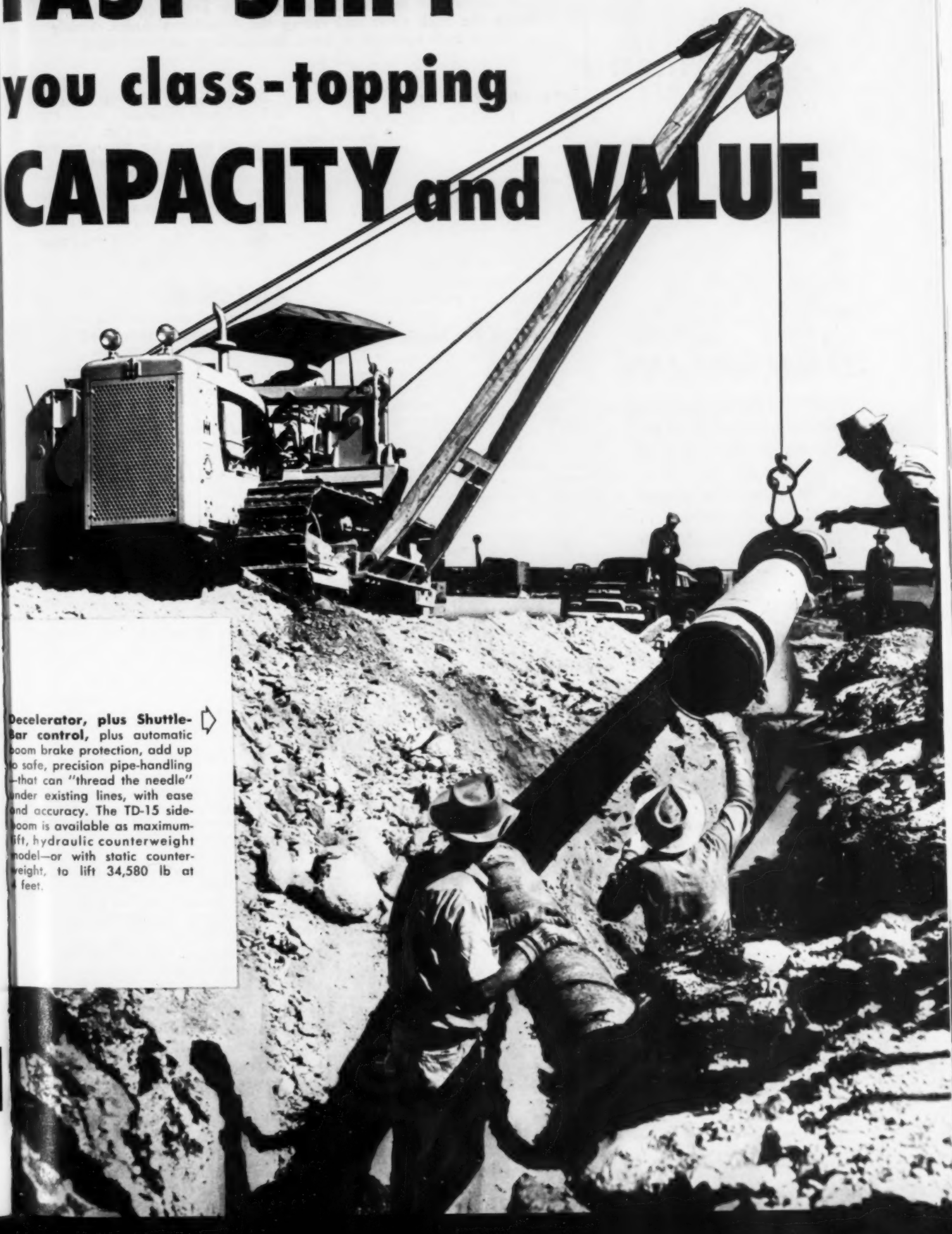


See your International Superior Distributor—measure TD-15 sideboom capacity, lowering-in pipe as big as 24"—stringing 36" pipe—doing pipeline utility, and maintenance work with stand-out speed and economy! Compare TD-15 sideboom operating ease and safety. See how this easy-to-haul, big-capacity, fast-stepping unit can "ram-rod" for a spread of king-sized booms. Ask for a demonstration!

INTERNATIONAL HARVESTER

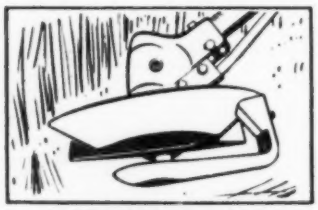
INTERNATIONAL®
SUPERIOR®

FAST-SHIFT you class-topping CAPACITY and VALUE



Decelerator, plus Shuttle-Bar control, plus automatic boom brake protection, add up to safe, precision pipe-handling —that can "thread the needle" under existing lines, with ease and accuracy. The TD-15 side-boom is available as maximum-lift, hydraulic counterweight model—or with static counterweight, to lift 34,580 lb at 4 feet.

Rowco's portable power driven brushcutter is designed for rugged terrain . . . cleans out brush up to 4" in diameter at ground level. Safe, dependable . . . Rowco's BRUSHKING is a real worksaver. Write today for name of your distributor — Thousands in use. Literature for your asking.



GRASS TRIMMING ATTACHMENT

ROWCO
MFG. CO., Inc.
EMERALD STREET
KEENE, NEW HAMPSHIRE

Please send complete information on the Rowco Brushking.

NAME _____

STREET & NO. _____

CITY & STATE _____

New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers' Index. Simply circle code numbers of items desired—sign and mail card.

Internal Coating

Allied Paint Mfg. Company has published a four-page brochure on its internal "pipe-kote." The bulletin gives details on components of internal paint and directions for preparing pipe and applying the paint to it.

While under normal temperatures the coating will set-up firm within an hour or two and will reach 75 percent of its hardness within 24 hours.

To get a copy, circle **No. E13** on Readers' Service Card, last page this issue.

Corrosion Protection

Chase & Sons, Inc., Corr-Prev Division, has issued a bulletin on its protective tape and wrap. The Corr-Prev system offers Chaseprime, Chasekote and Chasewrap. The liquid adhesive compound, Chaseprime, is applied only in low temperature conditions or when surface of pipe demands primer. Chasekote is polyethylene tape which comes in two thicknesses. Chasewrap is the outerwrap applied over the tape.

To get a copy, circle **No. E14** on Readers' Service Card, last page this issue.

Diesel Engine

A 16-page catalog has been issued by International Harvester Company on its six-cylinder diesel engine UDT-817. The four-cycle engine is available in turbocharged or naturally-aspirated models. Both versions are direct-start, direct-injection engines, with only minor differences in compression ratios, camshaft profiling, timing and piston design.

To get a copy, circle **No. E15** on Readers' Service Card, last page this issue.

Mobile Crane

The Thew Shovel Company has released a four-page bulletin on the new 65-ton Lorain Moto-Crane model MC760. This machine features hydraulically operated "Power-set" Outriggers as standard equipment, sturdy non-weave chassis frame, planetary rear bogie axles, turnpike speeds up to 37.6 mph and precision control with spur gear driven boom hoist.

To get a copy, circle **No. E16** on Readers' Service Card, last page this issue.

Oil Cooler

Young Radiator Company has published a 10-page, 2-color Oil Cooler catalog. The booklet includes complete data on Young oil to air to water oil coolers for torque converters, industrial applications and marine transmission.

Descriptions and photographs on mobile and stationary applications up to 600 hp are included in the catalog. Diagrams of oil to air coolers for torque converters, hydraulic oil and lube oil with performance charts, diagrams of oil to air coolers including dimension tables, fan specifications, and performance graphs are also included.

To get a copy, circle **No. E17** on Readers' Service Card, last page this issue.

Alloy Chains

A 16-page bulletin on TM alloy chain and sling chains has been issued by S. G. Taylor Chain Company, Inc. Included in the detailed catalog are specifications and suggested working load limits for single, double, triple, and quad branch alloy slings, miscellaneous slings and alloy chain attachments. Complete recommendations for inspection, care and use of TM alloy chain are given.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

Leak Testing

General Electric Company has published a six-page folder on leak testing of tanks, piping and other enclosures. The bulletin gives instructions on use of halogen leak detectors for finding leaks in enclosures that can be pressurized. The publication includes discussion of system preparation, testing procedures, quantitative measurement techniques and calibration.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

Color Horizons

Rust-Oleum Corporation has issued a 38-page catalog on rust and corrosion control with protective coatings. Rust-Oleum presents a system of primers and colorful top coatings with 67 actual color standards in the system.

A water-resistant system, heat resistant system, galvanized metal coating system, heavy-duty chemical resistant system, and speedy-dry system are described in detail in the publication.

To get a copy circle **No. E20** on Readers' Service Card, last page this issue.

Electrical Generators

Petbow Limited has issued an illustrated brochure with specifications and data on its complete line of portable electrical generators and welders for the petroleum industry.

To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

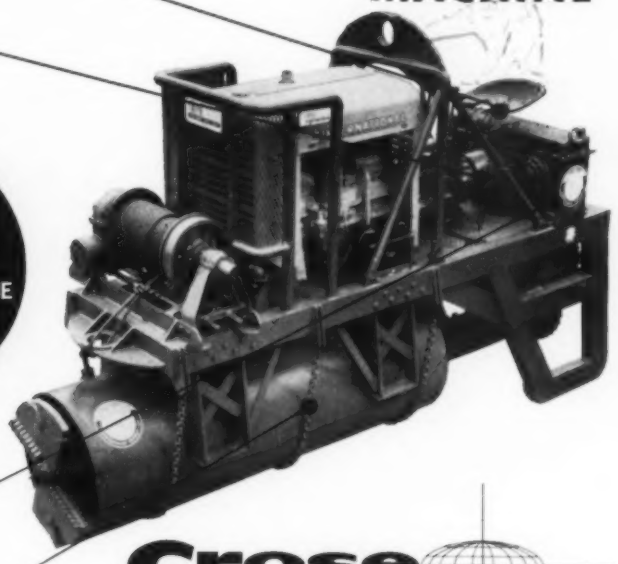
CENTER SEAT FOR OPERATOR — Sitting in seat located directly over center of machine, operator can keep casing lined up perfectly with hole being bored.

REVERSE-O-MATIC TRANSMISSION — With this new type transmission, operator can switch auger from forward to reverse without engine slowdown. No gear shifting.

HEAVY DUTY TORQUE CONVERTER — For full, constant speed and smooth power flow, eliminating up to 90% of shock load imposed on drive train.

CROSE

NEW ROAD BORING MACHINE



The new Crose Road Boring Machine provides the fastest, simplest, most economical way for boring crossings and installing casings up to and including 42" in diameter. Heavy duty torque converter and reverse-o-matic transmission deliver full, constant speed and smooth power flow . . . let you switch auger from forward to reverse without engine slowdown . . . no gear shifting.

FIELD-TESTED TOP PERFORMANCE

The smaller Model RBA Crose Road Boring Machine is still available for casing up to 24".

WRITE CROSE TODAY FOR COMPLETE INFORMATION

NEW GEAR AND CHAIN BOX — With pressure lubrication feature — has been added to the new Crose Road Boring Machine for greater power capacity.

CASING CLAMP BANDS ELIMINATED — Instead, you use adjustable casing chains which can be easily installed or removed when machine is in ditch.

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For a top man with intimate knowledge of electronics as applied to the petroleum, oil and gas pipeline industry, ASCOP offers an outstanding position with an excellent future.

The position calls for applications engineering, influence of new designs, and heavy technical sales back up for ASCOP's already established, successful, supervisory control, alarm annunciator and telemetering equipment. Considerable scope and responsibility will be given to the man who fills this position.

If you have the background in pipeline electronics and communications, please contact Mr. M. T. Jacobs to arrange a personal interview.

ASCOP

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P. O. BOX 44 — PRINCETON, N. J.
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HOT & COLD APPLIED COATINGS

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Why tie-up your capital in purchasing equipment, when you can rent all these items, and numerous others, for pipeline construction. And you get around-the-clock service from our experienced personnel . . . dependable operation of equipment assured by periodical checks. No delay, parts and supplies shipped same day ordered when possible.

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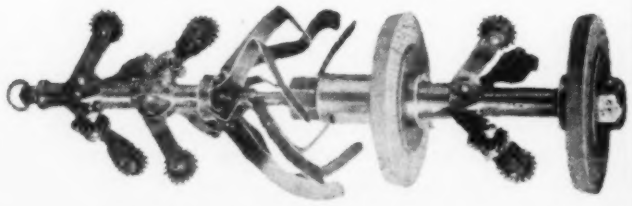
Go-Devil

NORTHRUP GO-DEVILS

Heavy Duty Model with Neoprene cup or disc drivers



G. A. COTTEN CO.

Manufacturers of **TRANSIT PIPE LINE SCRAPERS**

NORTHRUP GO-DEVILS &

P. O. Box 5332

Tulsa, Okla.

Installed on caustic lines in 1930, these Rockwell-Nordstrom lubricated plug valves needed only cleaning before installation in new plant.

THE VALVES THAT WOULDN'T RETIRE

The Rockwell-Nordstrom lubricated plug valves shown above were two of dozens installed in 1930 on caustic lines at a process plant. When the plant was torn down in 1959, the valves were still in such good condition that they're being used on the same service in the new plant.

The above story is just one more example of the ruggedness of Rockwell-Nordstrom valves. Since they're sealed positively against leakage by pressurized lubricant and there are no exposed metal-to-metal seats, you get positive shut-off year after year. And, lubrication is preventive maintenance against the high cost of repairs, replacement and downtime. To get complete details on Rockwell-Nordstrom, the original and world's most complete line of lubricated plug valves, lubricants and accessories, write: *Rockwell Manufacturing Company, Pittsburgh 8, Pa.; Canadian Valve Licensee: Peacock Brothers Limited, Montreal, Quebec; Rockwell International S.A., Geneva, Switzerland.*

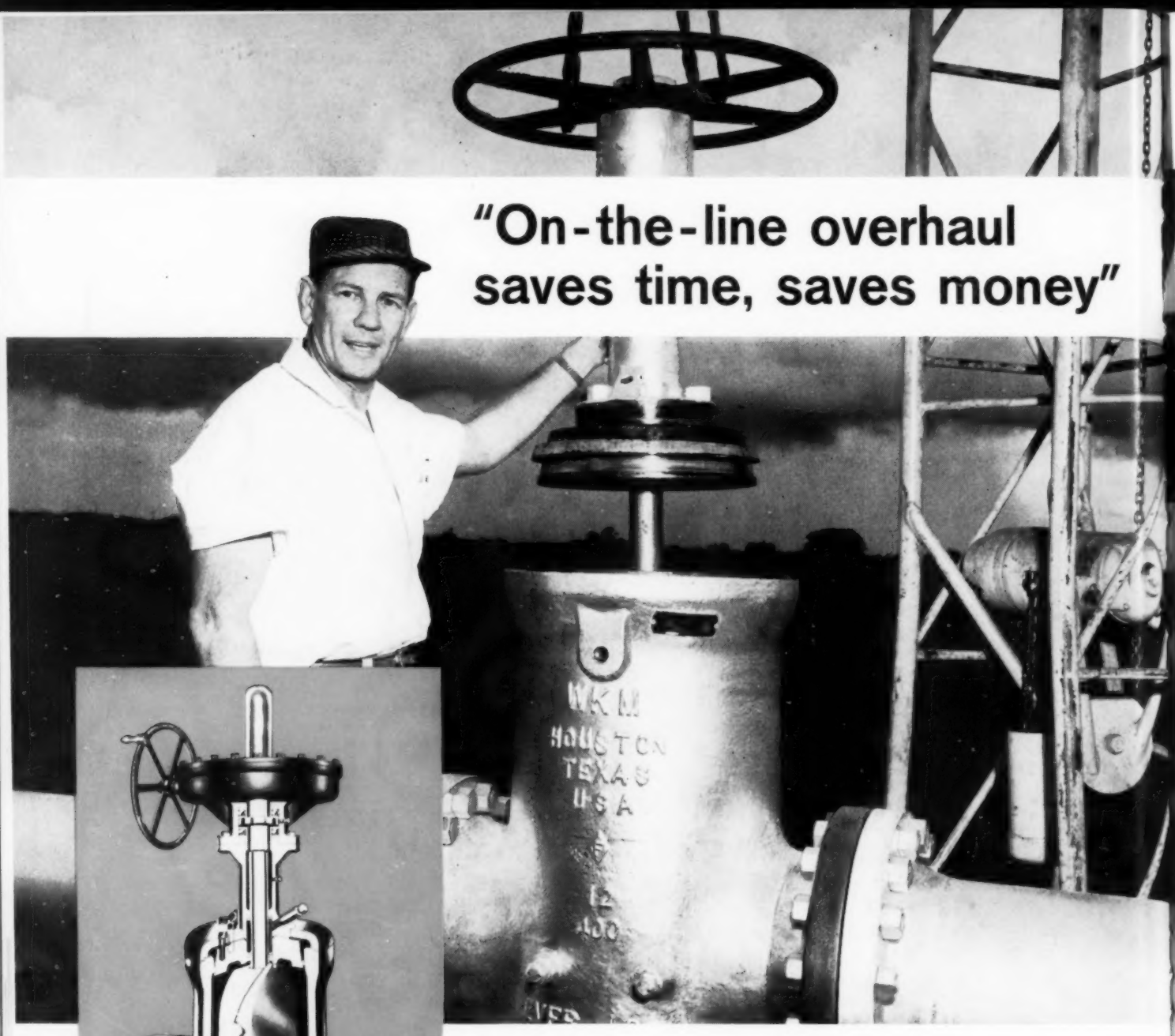
Lubrication Makes The Difference

ROCKWELL-Nordstrom VALVES

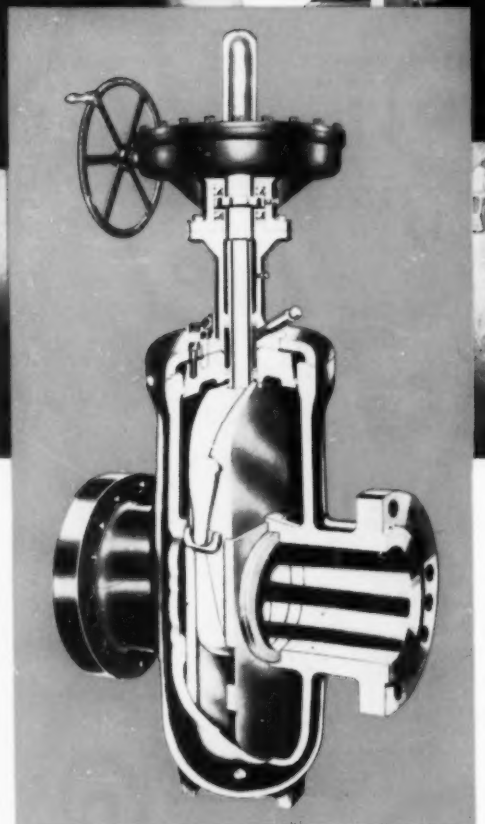
another fine product by

ROCKWELL

One of the newest Rockwell Hypresphere lubricated spherical (full round opening) pipeline valves. Because it's lubricated, it will last the life of the pipeline.



"On-the-line overhaul saves time, saves money"



W-K-M Leverlock® Gate Valves feature through-conduit gate construction, parallel expanding gates, exclusive gate centralizers, controlled force seating, pressure seal bonnets, super-finished stems, seating surfaces sealed from the lading flow.

Pressure Ratings: ASA 300 through ASA 1500 pounds.

W-K-M® ASA Gate Valves

These valves can be overhauled fast and easy. No other valves give you the same long-lasting service and economy. No other valves require so little maintenance, yet provide such outstanding efficiency and performance.

Next time — and every time — specify W-K-M! *Available at leading supply stores everywhere* (from 2″ through 12″). Sizes through 34″ available on special order.

PRODUCT OF W-K-M's *Creative Engineering*

WRITE FOR CATALOG 300

W-K-M

DIVISION OF ACF INDUSTRIES INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

5913-R